Public private partnerships

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Introduction

Traditionally, among the various functions assigned to the public sector, it is primarily responsible for providing citizens with a set of public services (such as health, education or welfare) and for constructing basic infrastructure (roads, bridges, railways, etc.). There are three main economic reasons for these public interventions. The first reason is market failure, as the private sector is normally not interested in these types of services or projects because it may take too long to recuperate the heavy initial investments. Second, these interventions are usually regarded as a public good (see for instance (Arrow, 1970; Arrow & Lind, 1970)). Third, providing infrastructure to the community generates positive economic and political externalities.

These positive externalities are most often the motivation behind which the project is decided, and not its profitability or financial value. These are the benefits of a social order, such as reduced illiteracy, improved health conditions in the population or fewer accidents. While all this has an economic value, that value may not always be financially expressed and is not always reflected by revenues directly associated with the project.

There is a vast body of economic literature on externalities from public sector intervention and investments. The impact of the role of government and public investment in development and economic growth (Barro, 1988) or externalities and taxes as a form of financing public expenditure (Mayeres & Proost, 1997) have been widely discussed. Regarding economic growth, public investment can have two effects: an impact on the GDP, through macroeconomic rates of return and public investment, can induce more or less private investment (the crowding in-out effect[1]) (Afonso & st. Aubyn, 2009). This last effect causes, on one hand, an increase in public spending that reduces the amount of credit available to the private sector (either by taxes or debt); however, on the other hand, by making available relevant infrastructures, better conditions are created for private sector operations.

Infrastructural investments produce positive externalities that affect the society as a whole. This occurs when the actions of firms or consumers impose costs or confer benefits on third parties, which the firms or the consumers fail to take into account when choosing their actions (Brealey, Cooper, & Habib, 1997). Often it is argued that infrastructures lower fixed costs, attracting companies and factors of production and thereby increasing production (De Haan, Romp, & Sturm, 2008). This way, infrastructures may have a significant impact on private sector productivity.

Another example is that building a road will reduce the travel time of people and goods while simultaneously reducing the accident rate and having a positive impact on the level and quality of life of

[1] This refers to whether public investment is productive and contributes positively to growth, either directly or indirectly via private investment decisions. Public investment may induce private investment, directing the attention to increases in the productivity of private capital resulting from the accumulation of public capital through public investment (Aschauer, 1989 and Hatano, 2010).

people who use that route. On the contrary, this intervention can lead to more traffic, thereby yielding a negative externality: more pollution. However, neither outcome has a direct financial impact on the road, which can be measured. Public projects should account for not only the financial revenues and costs but also the benefits of each project, including externalities and other non-market impacts.

Additionally the public sector must guarantee universal access to certain types of goods and services, such as health and education. Otherwise, burdening citizens directly for these costs would cause the exclusion of a portion of the population. The infrastructure also presents the reason that, in the case of a high investment, the profitability can only be long-term and, as such, is difficult to implement by the private sector. Moreover, investment and provision of these services is crucial to economic development, well-being and quality of life, as well as for the correction of inequalities and asymmetries, whether social or regional.

Despite the public sector role, over the last two decades, the private sector has emerged has an actor in these fields (particularly in building and operating infrastructures). During the past 20 years, various governments (at the central, regional or local level) were replacing part of the traditional public investment through the use of Public-Private Partnerships (PPPs). A recent study by the European Investment Bank (EIB) indicates that in 2009, there were more than 1,500 in Europe PPPs, with a cumulative investment of € 250 billion. PPPs have become increasingly used by governments, with two main objectives: address the infrastructure gap or the population's need for public services (under the budgetary constraints) and bring to these projects and services the private sector's higher level of efficiency (Grimsey & Lewis, 2002b, 2005a, 2005b).

Therefore, we can conclude from the literature and practice that the PPPs' main objective is to create Value for Money (VfM). VfM provides the same quantity and quality of services at a lower overall cost (i.e., the whole-life cost required to meet the user´s requirements) (Ball, Heafey & King, 2007). Fitzgerald (2004) argues that VfM can be delivered through risk transfer, innovation, greater asset utilisation, and integrated whole-life management. Debande (2002) and (Quiggin, 2005) add that the benefits of PPPs should compensate for the additional costs of recurring to private sector financing because, traditionally, the public sector faces a low cost of debt (the risk free rate). Returning to the externalities of public investments, how should these positives (and negatives) be addressed in cases where the investment is made under a Public-Private Partnerships (PPP)? It could be argued that if the government is pursuing developing the project, then the way the project is developed and financed is neutral in terms of externalities. This way, we separate the investment decision from the public decision, even for public investments. However, it could also be argued that due to budgetary constraints, if the project were not developed under a PPP scheme, it would not be developed; consequently, there is some argument to account for the externalities in the PPP value. Externalities of various types (e.g., environmental side-effects) may require some form of regulation but does not rule out the private supply of the infrastructure assets and associated services (Grimsey & Lewis, 2004).

However, PPPs are often criticised as an 'off-budget temptation' for governments (especially when fiscal constraints are binding). PPPs can enable governments to make public investments and postpone the expenditures without compromising the current budget and debt. For the last several years, there has been extensive discussion in the European Union, whether public investment should count for the budget deficit threshold established under the Maastricht Treaty.

Other criticisms on PPPs have been raised: (i) the real levels of enhanced efficiency (Glaister, 1999); (ii) the level of accountability of PPPs (Broadbent, 2003; Froud, 2003; Asenova & Beck, 2010); (iii) the efficient government management of the (unavoidable) problem of incomplete contracting (Blanc-Brude H. Goldsmith & T. Valila, 2006, 2009); and (iv) the level of VfM generation for the public sector (Grimsey & Lewis, 2002a, 2005b).

Why study PPPs and Project Finance? Despite the relevance of this topic, there is very little research in the economic and finance field. This gap between practitioners and theory must be addressed and means a requirement for understanding this phenomenon from a finance perspective: what are PPPs and project finance, how they create value for the public and private sectors, and how they are structured and financed.

As for each project, a specific PPP company is created (SPV – Special Purpose Vehicle), which has several characteristics relevant for economic and finance studies: it is possible to observe the determinants and impacts of decisions in a more transparent and clear way (Esty, 2004). The author states that the fact that the project companies are standalone entities allows researchers to more easily observe the structure details and the performance outcomes. Additionally, the high leverage, the complexity of the operation, the relatively small number of shareholders, the dividend policy of not being allowed to reinvest in other businesses, and the debt priority and interest rates differ from Corporate Finance principles.

Therefore, and despite the increased research over the past years, this is still a most unexplored subject. We expect research on PPPs to increase substantially over the next years, not only as the projects already undergoing tend to mature but also by expansion of the concepts beyond Europe, becoming a worldwide phenomenon.

Why study PPPs using the Portuguese case? Since 1993, Portugal has been using PPPs intensively, mainly for highway construction and in the health sector. Portugal has used PPPs to build an extensive highway network. This network has increased by 700% between 1990 and 2007, similar to Ireland (+900%) and Greece (+500%) (Cruz & Marques, 2011). By 2012, Portugal had constructed 2,700 km of highways aiming to reach 4,000 km by 2014. This places Portugal among the countries with the highest density of highways in Europe.

According to the European Investment Bank (EIB), Portugal was responsible for 3% of a total of 1,340 PPP projects in Europe and 7% of a total of €254 billion in investment. Because Portugal only accounts

for approximately 1% of Europe's GDP, further calculations by (Sarmento & Reis, 2012) show that Portugal leads in the use of PPPs across Europe.

As one of the leading countries using PPPs, the Portuguese experience is impressive, relevant, and an interesting study subject. However, there has been little discussion and research, with only a few studies published: (De Lemos, 2004; Monteiro, 2005; Sarmento, 2010; Basílio, 2011; Cruz, 2011; Cruz & Marques, 2013 a, b and Sarmento & Renneboog, 2014).

Thirty-five PPP projects were launched in four sectors: roads (22), railway (2), health (10) and security (1). In total, €20 billion was invested between 1995 and 2014 with the road sector accounting for almost 94% of this investment and railways and health representing 3% each. The future payments due by the state to honour these contracts are estimated to represent an annual effort of a little above 0.5% of GDP until 2030, but between 2014 and 2020, these payments will amount to 1% of GDP. Using the 6% legal discount rate that is used by the public sector to evaluate projects, the payments for 2014 and beyond have a net present value of approximately 12% of the current Portuguese GDP.

Along with the heavy value burden of PPP contracts for the public sector, one must also consider the extremely rapid pace with which these many contracts were set up. This was done without necessarily ensuring that the administration was capable of managing them all. The novelty of the experience, added to the fact that the governments were not prepared for the level of complexity some of these contracts introduced, led to some questionable decisions. Doubts about whether PPPs represent value-for-money have emerged for the Portuguese case. There are several reasons why the PPPs were unsuccessful: (i) the concentration of PPP projects was very high over a limited time span, and the public sector was not prepared and did not have the ability to manage and control the contracts; (ii) the motive to resort to PPPs was mainly to avoid budget constraints rather than to use public resources better by taking advantage of private sector efficiency; (iii) the risk allocation between the private and public sector was flawed because the private sector bore too little risk, and payments from the public to the private sector were considerably above the investment cost.

Despite the enormous effort over the last 20 years to close the infrastructure gap, Portugal still needs to continue to invest in certain areas, such as health, water, and sanitation or railways. As tight budgetary restrictions will last for at least another decade, governments will continue to use PPPs. In Portuguese-speaking countries (Brazil, Angola or Mozambique), the Portuguese experience could be an interesting example to improve upon (Basílio, 2011).

Because of the large number of projects, PPP research in Portugal is expected to grow in the future. In particular, the abnormal frequency of renegotiations deserves more interest, as does the PPPs' efficiency relative to other forms of public procurement. Especially for the health sector, contract analysis, accountability, and risk analysis should be examined in order to generate policy recommendations. An international comparison with other countries, particularly those also in a difficult budgetary situation with a high use of PPPs (such as Greece, Ireland or Spain) is warranted.

The five chapters of this thesis examine several PPP aspects.

The first chapter (co-authored with Prof. Dr. Luc Renneboog) is a literature review on risk allocation, valuation and VfM, using some examples from the Portuguese experience. This paper reviews the principles and fundaments of risk from either the government or academic perspective. We reach the conclusion that although risk allocation is considered a key aspect in VfM, academics are sceptical if the PPPs evaluated had created VfM as the governments reached opposite conclusions.

Chapter 2 (co-authored with Prof. Dr. Luc Renneboog) uses a case-study methodology to review the PPP life cycle. We address several issues including the following: from the public sector perspective, how are PPPs different from public procurement and privatisation? Additionally, what are the advantages and disadvantages of PPPs, and how do they interact with one another—with some advantages leading to possible disadvantages. From the private sector perspective, we show how PPPs and Project Finance differ from the traditional firms and the Corporate Finance principles, in terms of company structure, finance, shareholders and dividend policy. Finally, the two case studies also address a crucial issue in PPPs: renegotiations. By using these two cases, we introduce the subject of study in Chapter 3.

Chapter 3 (also co-authored with Prof. Dr. Luc Renneboog) describes the Portuguese experience in PPP renegotiations. Using a data panel of 254 renegotiation events, we are able to determine which sector, project, political, legal and economic variables affect the likelihood of renegotiation, the renegotiation motive and the duration of each event. There is some evidence of opportunistic bidding leading to more renegotiations, as PPPs in the operational stage are also more likely to renegotiate. Moreover, majority governments appear to be more prone to renegotiate, although political cycles (defined by the nearby of elections) appear to have no effect. A better institutional framework, defined as a low country risk, a strong rule of law, and lower corruption, tends to reduce the probability of renegotiations. There is also evidence that during periods of higher corruption, more renegotiations occur.

Chapter 4 (co-authored with Prof. Dr. Luc Renneboog and Prof. Dr. Pedro Verga Matos, from ISEG/Lisbon) addresses the PPP efficiency by using seven highway projects and the Malmquist index efficiency model. Not only is there evidence of poor management due to a lack of competitive pressure, but the increased use of outsourcing in these companies has also increased inefficiencies. The introduction of tolls and the outburst of the economic crises in Portugal have substantially reduced traffic, further contributing to inefficiency. Finally, the local context, such as highways in low-income areas and rural regions with a lower traffic density affect PPP highway performance.

Finally, chapter 5 (co-authored with Prof. Dr. Luc Renneboog) addresses the public sector efficiency in building infrastructures by public procurement. There is a clear relationship between the public sector efficiency in infrastructure projects and PPPs. To achieve VfM, the PPP costs must be below the public sector costs. This is determined by using the Public Sector Comparator (PSC). According to (Sarmento, 2010), the PSC is based on estimates of full costs, revenues and risks, set out in cash flow terms, discounted at the public sector rate to determine the net present value (NPV), and after that is compared

with the discounted value of payments (along with risks and costs retained by the public sector) to the private supplier. The public sector comparator is therefore the financial difference between the two procurement options for the same project (Grimsey & Lewis, 2005). As the public sector tends to be less efficient than the private sector, it is necessary to have realistic and reliable values of how inefficient the public sector will be, in either construction or operational costs. This chapter addresses the first stage of projects (the construction costs).

We analyse the cost overruns and identify which project, political, legal and economic variables can affect the size and the probability of a public project having cost overruns. Using a sample of 243 public projects, we found that the average cost deviation amounts to 24%. Large projects, which are often more complex, have a longer duration, are subject to higher risk, and have a higher cost deviation and a higher probability of cost overruns. Local and regional governments appear to control costs better than the central government does. Cost overruns are more likely in election years, as politicians seem eager to conclude infrastructural investments, and consequently, they inaugurate a new service to harvest political goodwill with the population. Over time, cost deviations are reduced due to other factors, such as more experience or increased fiscal constraints. Less corruption reduces not only the level of deviations but also the probability of cost overruns.

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Chapter 1

Public-Private Partnerships: Risk Allocation and Value for Money

ABSTRACT:

This paper addresses the allocation and valuation of public-private partnerships (PPPs), by reviewing the literature and using the Portuguese case to provide some practical examples. First, the paper discusses why governments pursue PPPs and how value for money (VfM) is achieved. Second, the paper reviews the principles of risk allocation and valuation from an academic and public sector perspective. Both the private and public sector consider risk allocation to be a critical issue with respect to PPPs and VfM generation, although governments adopt a less complex approach to risk measurement. This paper analyses papers, case-studies, and reports concerning VfM from PPPs and concludes that, from an academic perspective, the majority of PPPs do not create VfM (government reports usually reach the opposite conclusion).

KEYWORDS: Public-Private Partnerships; Risk; Risk Allocation; Value for Money

JEL CLASSIFICATION: G32; G38; H54.

1. Introduction

Public-private partnerships (PPPs) are increasing in number worldwide and are used to build and manage large public infrastructure projects. PPPs enable countries, especially those with significant fiscal constraints, to initiate public asset construction while decreasing the fiscal burden during the investment phase (although this burden may increase at a later stage). PPPs incorporate private sector expertise and superior management to public sector projects with the aim of achieving higher levels of efficiency. However, concern exists with respect to the efficient use of public money in PPPs. There is debate surrounding the efficiency of PPPs in the realm of public procurement and, specifically, the value for money (VfM) effect of PPPs in the public sector.

VfM is defined in the literature as private sector services provided at a lower cost than the same quality and quantity of services provided by the public sector. The lower costs offered by private companies are achieved from greater efficiency (at least when compared to public organisations). Prior to the 2008 financial crisis, private sector finance costs were higher than the risk-free rate that the public sector traditionally applied. PPPs will only create VfM if there is private sector efficiency that sufficiently compensates for the price difference between the project´s weighted-average cost of capital (WACC) and the risk-free rate (Rf). The efficiency advantage from the private sector affects the construction and operational phases of projects because superior management leads to lower costs,

fewer delays, and reduced budget overruns. The efficiency advantage stems from the allocation and management of risk. Transferred risk is better managed by the private sector; therefore, costs are lower than they would be if managed by a public entity. Hence, the allocation of risk and appropriate risk valuation models are critical issues for PPPs.

This paper will address four questions. (i) How is risk allocated in PPPs? (ii) How is risk valued? (iii) Do PPPs create VfM? (iv) Is risk allocation essential to create VfM? With respect to the first question, risks should be allocated to the party best able to manage them and to achieve an optimal risk allocation. Determining how to achieve an optimal risk allocation is complex to verify; however, only an optimal risk allocation reduces costs and effectively manages incentives so that a PPP will generate VfM. In relation to the second question concerning risk valuation, our survey shows that studies and analyses are recent and limited in number. Although academics (unlike governments) use advanced research techniques (mainly value-at-risk (VaR), cash-flow-at-risk (CFaR), and real option analysis), research studies are few and limited in scope. Therefore, further analyses are required, and more detailed techniques must be considered. Our survey also shows that governments use basic tools to value risks. With the exception of South Korea (which uses a Black-Scholes model), most countries rely on value sensitivity analysis based on the capital asset pricing model (CAPM) or the equity risk premium. Despite frequent use of Monte-Carlo simulations, we believe that a government qualitative approach ought to be complemented with more quantitative analyses. The risk assessment from the government perspective remains limited and may be a result of inexperience in the public sector, a lack of knowledge, or insufficient data.

We conclude, despite the limited literature, that both academics and practitioners unanimously agree that risk is fundamental for VfM; however, their agreement ends here. Most academic studies show that PPPs projects do not generate VfM. We demonstrate that academic papers focus on five main points of criticism, all of which are related to risk. Contrastingly, the majority of government reports conclude that PPPs create VfM, although some of these reports have obvious pitfalls. We provide evidence that government reports are biased in favour of PPPs and present possible explanations.

This paper is organised as follows. Section 2 provides an overview of the PPP concepts, VfM, and private sector efficiency. Section 3 reviews the academic literature and government guidelines on the allocation and valuation of risks. Additionally, this section provides insights on the risk-related behaviour of the different PPP parties and how the individual parties manage controversial risk. This section addresses the first and second research questions (i.e. how risk is allocated and valuated). Section 4 reviews relevant papers, case studies, and government reports concerning VfM and risks and addresses the last two research questions: Do PPPs create VfM, and is risk allocation crucial in this context? Section 5 presents the conclusions.

2. The concept of Public-Private Partnerships

2.1 What are PPPs?

A PPP has been defined as *'an agreement where the public sector enters into long-term contractual agreements with private sector entities for the construction or management of public sector infrastructure facilities by the private sector entity, or the provision of services (using infrastructure facilities) by the private sector entity to the community on behalf of a public sector entity*' (Grimsey & Lewis, 2002, pg. 248).

However, there are many definitions of a PPP in the literature.[1] The ambiguity exists because PPPs are a recent phenomenon (the first PPPs appeared in the UK in the early 1990s) and governments worldwide have taken different approaches to PPPs. Using the dimensions of control, funding, and ownership, Zarco-Jasso (2005) identify eight types of PPPs. PPPs are substantially different from full privatisation and, according to Vega (1997), the difference lies in the transfer of risk. In a privatisation, all risks are transferred to the private sector, whereas some risk from a PPP is retained by the public sector. Moreover, contractual arrangements are the core of PPPs (Demirag & Khadaroo, 2008) and extend over finite (but long) periods.

PPPs are mechanisms that blend traditional procurement and full privatisation (Grimsey & Lewis, 2005a). Boardman (2010) notes that PPPs combine government control and ownership with access to private sector efficiency and capital. In a PPP, the private sector is responsible for constructing, partial financing, asset operations, and the service provision. Despite intensive use, it remains unclear whether PPPs lead to more efficient use of public resources; however, the 'infrastructure gap' implies that the long-term global prospects for PPPs remain strong. Understanding government motivation in the use of PPPs and their ability to enhance public sector efficiency is valuable for future PPP success.

2.2 Why do governments use PPPs?

Governments have increasingly employed PPPs in the last few decades to finance and manage complex operations. The additional private sector involvement has caused a reduction in public sector investment in new and old infrastructure development. Governments expect that private sector management enables a better allocation and a more efficient use of public resources. However, despite the intensive use of PPPs, their effectiveness is not unequivocal. Debande (2002) states that PPPs use private capital to build infrastructure, which may not otherwise be possible without private funds

[1] Among others: (HM Treasury, 1998; Akintoye, Beck, & Hardcastle, 2003; European Commission, 2003; Bovaird, 2004; Corner, 2006; Hodge & Greve, 2009; Klijn G. R., 2000; Linder, 1999; OECD, 2008; Osborne, 2000; Savas, 2000).

because of significant government budget constraints. Another advantage to PPPs is that public authorities can focus on strategic priorities and rely on the private sector to manage operations. This provides comparative advantage in terms of efficiency (provided the private sector has incentive). The main benefit of PPPs is private sector efficiency (from higher quality management) and a reduction in construction and operational cost deviations.

However, PPPs are often criticised as an 'off-budget temptation' for governments (especially when fiscal constraints are binding). PPPs can enable governments to make public investments and postpone the expenditures without compromising current budget and debt. However, PPPs can dilute political control over decision-making in the public sector. Bovaird (2004) argues that PPPs can undermine competition. Still, whether that issue is related to the structure of PPPs or the fact that the sectors in which PPPs are set up are low-competition is unclear. Other criticisms on PPPs have been raised: (i) the real levels of enhanced efficiency (Glaister, 1999); (ii) the level of accountability of PPPs (Broadbent & Laughlin, 2003; Froud, 2003; Asenova & Beck, 2010); (iii) the efficient government management of the (unavoidable) problem of incomplete contracting (Blanc-Brude, Goldsmith, & Valila, 2006) and, (iv) the level of VfM generation for the public sector (Grimsey & Lewis, 2002, 2005b).

This study addresses concerns with two fundamental questions: (i) Should the PPP be on or off the public sector balance sheet? (ii) Do PPPs yield VfM?

2.3 Should the PPP be on or off the public sector balance sheet?

Infrastructure development typically has two stages: construction and operation. The majority of infrastructure requires high levels of investments but low levels of annual operating and maintenance costs. Using highways in Portugal during the last 15 years, as an example, Sarmento (2010) finds that construction costs amounted to between €3,000,000 and €7,000,000 per km, whereas annual operating and maintenance costs were approximately €75,000 per km. This shows that the majority of the PPP financial outlay occurs in the first four or five years, during the construction stage. Therefore, accounting for this phase in the public budget is a key issue.

In traditional procurement, the investment is a public expenditure because it is recognised at the moment of payment, which affects the deficit and the national debt. In contrast, the majority of Eurozone countries consider the PPP as an off-balance sheet operation. Investments are considered as private because long-term construction and availability, or demand risk, are transferred to the private sector. Investments are not considered in the deficit and the debt during the construction years, placing the government in a better fiscal position. Future payments from the government to the private sector are recognised as expenditures, increasing the deficit in the payment years. This tendency has led many academics to criticise a PPP as an off-balance sheet temptation.

The temptation to deliver a public service through a PPP is a reflection of budget rather than efficient public procurement. The high levels of public expenditure for assets and services indicates that governments are concerned with public deficits to a greater extent than VfM. Hence, we conclude that governments use PPPs for a single purpose: to place certain public investment outside the public accounts. Figure 1 shows the tendency for countries with higher levels of public debt to use PPPs to a greater extent. This temptation is facilitated by the accounting mechanism that allows governments to build public projects and to simultaneously maintain public expenditure levels, taxes, and deficits by postponing PPP costs. However, problems regarding affordability may arise when the postponed payments emerge in the subsequent decades, as is the case with Portugal, Ireland, and Greece.

[Insert Figure 1 here]

The Portuguese case is an example of the "off-budget temptation" in PPPs. Portugal has used PPPs intensively to build an extensive highway network. This network increased by 700% between 1990 and 2007, similar to Ireland (+900%) and Greece (+500%) (Cruz & Marques, 2011). According to the European Investment Bank (EIB), Portugal was responsible for 3% of a total of 1,340 PPP projects in Europe and 7% of a total of €254 billion of investment. As Portugal only accounts for approximately 1% of Europe's GDP, further calculations by Sarmento & Reis (2012) show that Portugal leads in the use of PPPs across Europe.

Why did the government choose PPPs to build most of the highway network? The first motive was that highways built by PPPs did not have sufficient traffic do be financial viable. Therefore, they could be built under public procurement (meaning that the investment would affect the public deficit and debt) or by a PPP scheme. By 1995, Portugal was entering the Euro Zone and was facing a public deficit of 3% of the GDP by 1999[2]. Therefore, having this high investment in highways counting for the deficit would have undermined the fiscal position and could have compromised the purpose of entering the single currency. Additionally, the reallocation of EU funds to other fields reduced the funds available for the Portuguese road infrastructure. Hence, PPPs emerged mainly because of budget constraints, although the public sector was also expecting that the private sector would improve the quality and efficiency of the infrastructure. Given the size of the public payments for assets and services, several researchers have concluded that PPPs were used mainly to put public investment outside the perimeter of the public budgets (Marques & Berg, 2010; Sarmento, 2010; Sarmento & Reis, 2012). In 2011, Portugal was forced to ask for financial rescue from the troika (EU, ECB and IMF). The memorandum of understanding of the financial rescue packages included several measures regarding lowering the PPPs costs.

[2] Although Portugal achieved this 3% deficit by 1999 (with PPP investment contributing significantly to the balance sheet), excessive deficits after 2001 and to the time of this writing restricted the choice of public investment methods because of poor national budget conditions.

2.4 Are PPPs value for money?

VfM provides the same quantity and quality of services at a lower overall cost (i.e. the whole-life cost required to meet the user´s requirements) (Ball, Heafey & King, 2007). Fitzgerald (2004) argues that VfM can be delivered through risk transfer, innovation, greater asset utilisation, and integrated whole-life management. Andersen (2000) mentions risk as only one of the six drivers of VfM; however, this paper demonstrates that risk is the most crucial of the six.

The private sector must be more efficient than the public sector because the public sector's borrowing costs are lower. Since 2007, the sequence of property, bank, and government debt crises has brought some concern with respect to this rule for a number of countries. As long as public sector interest rates are lower than those of the private sector, PPPs will generate VfM if private sector efficiency is greater than the difference in financial costs. After all, if:

$$Rf < Rd < Re, \text{ then } Rf < WACC$$

then PPPs can generate VfM if:

$$\textit{Efficiency gains} > (WACC - Rf).$$

where *Rf, Rd*, *Re*, and *WACC* stand for the risk-free rate, the cost of debt, the cost of equity, and the weighted-average cost of capital, respectively.

Using the Portuguese experience shows the difference between private and public sector cost of capital. In average, PPPs were financed by 70% in debt and 30% in equity. The credit risk was considered low (mainly because the government retains the traffic risk), and therefore, the spreads are approximately 2% above Euribor. Figure 2 shows the difference in the cost of debt compared with the Portuguese risk-free rate. This allows us to conclude that the WACC of the projects is above (but not much above) the government borrowing costs. Therefore, this higher financial cost from the private sector must be compensated in order to generate VfM. This must derive from the private sector being more efficient in the construction, operation and risk management of the infrastructure.

Considering this fact, (Debande, 2002; Quiggin, 2005) add that the benefits of PPPs should compensate for the additional costs of recurring to private sector financing. The private sector has a higher discount factor for two reasons. First, the public sector faces lower risk because it does not default in the same way as private companies. Second, risks to the public sector are borne by the taxpayer. The risk premium is the market evaluation of the risk transfer to the private sector, and the higher financial cost forces the private sector to be more efficient.

The private sector is considered more efficient than the public sector because the former is subject to superior incentives towards cost-effective investments, to control operational costs and especially manage risks better. How to allocate risk and the choice of risk model assessment for PPPs are critical

issues in private sector performance. Grout (1997) demonstrates that inappropriate risk allocation, in conjunction with a lack of competition, innovation, and transparency usually leads to PPP failure. Risk transfer improves the cost efficiency of PPPs and renders them more cost efficient than traditional procurement. An effective transfer of risk from the public to the private sector can lead to a more explicit treatment of risk because it is the acceptance of risk that provides motivation to the private sector to price and produce efficiently.

According to Sarmento (2010), the public sector comparator (PSC) prior to the bid is an effective measure for evaluating VfM because it enables the public sector to base decisions on a financial evaluation of alternatives. The PSC is the difference between the costs for the public sector of a PPP payment and the cost of building the asset or providing it through traditional procurement. The PSC is based on full cost, revenue, and risk estimates in cash flow terms, discounted at the public sector rate to determine the net present value (NPV), and compared with the discounted value of payments to the private supplier (considering the risks and costs retained by the public sector) (Grimsey & Lewis, 2005b). The PSC is, therefore, the cost difference between the two procurement options for the same project. The authors argue that the PSC is simpler and easier to compute than any of its alternatives. The PSC offers a cost-effective trade-off between a full cost-benefit analysis of all project options (conducted in Germany) and the selection of the best private bid (the method used in France). The PSC ensures that all options are subject to the same analyses and tests. The PSC should be calculated prior to evaluating bids for two reasons. First, the PSC will be evaluated as a 'pure' public sector option and, second, it enables the public decision maker to understand the VfM elements that the private bid should reflect. Therefore, it is important to maintain a current PSC. The PSC becomes a negotiating tool for the public sector, enabling it to achieve the best possible deal.

The PSC should provide the base for costing. It represents a fair estimation of all costs, for the same level of volume and quality that the public sector would provide.

Once the NPVs of both the PSC and the PPP are adjusted to reflect comparable bases, they can then be compared. Ceteris paribus (i.e. with respect to quality and risk allocation), VfM is generated when the total present value of the cost of private sector supply is less than the NPV of the base cost of the service, adjusted for the cost of retained government risk, transferable risk, and competitive neutrality effects.

However, the PSC is liable to potential pitfalls in the forecasting cash flows and choice of an appropriate discount rate (Froud, 2003; Jean Shaoul, 2005). Grimsey & Lewis (2005b) add that the risk analysis required for the PSC is part of a broader process of risk identification, allocation, and management. In many cases, the difference between the PSC and the private sector proposal will be relatively narrow and the procurer has to make professional judgments as to the VfM to be derived from contracting with the private sector and the risks which that route involves.

3. PPPs and risk

This section presents an overview of the academic literature and government guidelines concerning risk allocation that is central to achieving VfM from PPPs.

Risk management with respect to PPPs is a potential factor contributing to efficiency (Stephen Glaister, Scanlon, & Travers, 2000). It consists of a structured approach to the identification, assessment, and control of risks that emerge during the policy, program, or project lifecycle (HM Treasury, 2003a). The identification of the source of risk is required to effectively manage risk.[3] Additionally, the responsible party for risk at each project stage and the management strategy for minimising the potential negative consequences of the risk during the entire project life must be determined (McDowall, 2003). Investment projects are vulnerable to behavioural biases: managers are concerned with the size of potential losses to a greater extent than the likelihood of a loss occurring (Helliar, Lonie, Power, & Sinclair, 2001).

In this section, we analyse how the three main parties in a PPP (the government, the private companies, and banks as lenders) address risk.

3.1 Risk and the PPP actors

The three main parties involved in a PPP are the public sector (the public entity that grants the service), a private company, and the private bank sector. Each partner holds a different perspective with respect to time, risk, and decision making (Forrer, Kee, Newcomer, & Boyer, 2010), especially concerning the identification, analysis, quantification, and allocation of risk. The different motives, goals, and values of the involved parties require successful cooperation and interaction and a high level of trust between the players.

3.1.1 The public sector perspective with respect to risk

There have been several developments in the PPP concept of risk. First, several innovations have been introduced in the field of risk identification, allocation, valuation, and management (Shaoul, 2005). Second, the public sector has a fixed payment schedule, which reduces financial risk. This fixed payment does not guarantee that there will be available resources in the public budget for these costs.

[3] According to (Kwak, YingYi, & Ibbs, 2009), no risk is applicable to all PPP projects and there is no consensus on a universal risk classification approach. The authors provide a comprehensive list of investment project risks. A similar list is found in (Tinsley, 2001) and a lengthy, descriptive list of risk is found in (Akintoye et al., 2001).

However, a fixed payment schedule is an advantage because the guaranteed and stable prices (even if higher) cater to public sector risk aversion. Third, the law of large numbers applies to the public sector with respect to risk as a probability. This advantage is also at the centre of the public sector´s optimism bias, often presented as a criticism. The optimism bias implies that the public sector accepts a lower probability of a negative event compared to other sectors. It can also be considered as systematic bias by appraisers in the over-estimation of a key project's parameters. There are several reasons for this bias. Optimism is common in the public sector because the sector often suffers from poor management and inadequate information. However, the main reason for the bias is that losses are borne by the taxpayer, whereas they are borne by the shareholder in the private sector.

The use of PPPs also entails certain disadvantages (for the public sector). PPPs reduce the public sector's power in addressing changing needs and circumstances (Quiggin, 2005) because there is limited opportunity for the renegotiation of contracts (following the principle of pacta sunt servanda). Additionally, even in cases where a renegotiation of a contract is possible, the private sector has a significant advantage from information asymmetry. Another criticism in literature is the paradox of infrastructure investments (Gleason, 1995). The paradox stems from the high risk associated with high returns because, as noted by Esty (2004), the sponsor may appear to profit excessively at taxpayer expense. Excessive private sector profits can generate an aversion to investment trough PPPs.

There is a perception that the public sector carries a lower level of risk than the private sector with respect to investment and financing choices (Sarmento, 2010). Public sector investments have not, historically, distinguished between investment and financing decisions: investments are frequently undertaken when credit is cheap and abundant, although the investment decision should consider opportunity cost (i.e. whether there is no better alternative use for taxpayer money). Consequently, the minimum hurdle rate that the public sector employs is often lower than that of the private sector, a situation exacerbated by public sector consideration of variables such as public interest, economic externalities, and social assistance in addition to maximum value. Brealey, Cooper, & Habib (1997) question whether governments view public sector projects as low risk, or whether governments consider that projects are low risk because they are undertaken by the public sector. The authors show that the evaluation of the investment should be independent of the financing source. The fact that the public sector usually has a lower interest rate should be irrelevant in the evaluation of a project. Too often, countries approve projects because there are available resources and not because of their economic or social value. Because PPPs have no impact on the public deficit during the investment phase, they have become an off-budget temptation. Hence, not separating the investment and financing decisions has led to a myopic perspective by the public sector with respect to investment and a misjudgement of risk.

Successful public sector risk management requires a proactive rather than a reactive approach. PPPs force the public sector to examine risk in alternative ways than traditional public procurement. Private sector experience with risk and greater incentive to deal with risk implies a private sector advantage

when negotiating with the public sector. The next subsection explains why the private sector is efficient in managing risk.

3.1.2 The private sector's perspective on risk

The private sector has traditionally been better prepared to deal with risk for two reasons: (i) the private sector exhibits no optimism bias concerning risk. Such bias would increase bankruptcy risk and, (ii) private sector project financing is conducted with substantial experience in risk estimation and management. Two private sector players are involved in PPPs: the company (and sponsors) and the lender. How they behave towards risk, with each other and the public sector, is analysed in this subsection.

Sponsors of PPPs are investors who are responsible for the project and the equity capital. Because a PPP is developed under project finance rules, sponsors only receive the return on their investment in the final stage. Project finance has a cascading cash flow, whereas revenue distribution follows a specific order: operating and maintenance costs, taxes, debt services, and equity returns. Therefore, sponsors assume the highest financial risk and require a higher return on equity than the cost of debt. However, if the project defaults, they lose the capital they invested. From the sponsor's perspective, the low level of equity does not imply a higher propensity for risk.

From a private capital perspective, the high scale of investment, delayed payback period and maturity, and the various risks involved can make a project extremely risky. Usually, lenders show greater concern for risk than sponsors because PPPs rely on debt to a greater extent than equity. Esty (2004) shows that debt on PPPs represents 70 to 90% of the investment, which is three times more than traditional corporate financing companies. Because banks assume the majority of the financing, their risk aversion increases and they are eager for the project to assume as low a level of risk as possible.

Banks are involved in the early phases of projects. They gauge projects to ensure acceptable risk levels and sufficient project cash flows for the debt service (Asenova & Beck, 2010). Lenders are concerned with the level of risk transfer to the PPP and the reallocation of risk to third parties. Lenders would prefer that the PPP resemble an 'empty box' in terms of risk (Yescombe, 2013) and have become reluctant to accept any but the most limited and measurable risk. If a project is low risk, it enables the bank to lend greater amounts at a low interest rate. Therefore, the difference between the WACC and Rf may not be that high. Consequently, the private sector's efficiency should be sufficient to overcome the difference and generate VfM. Lenders bear the financial and bankruptcy risks and, if project revenues fall below estimates (or in the extreme event that the project defaults), lenders are not repaid. However, the low likelihood of such an event enables banks to support projects under suitable conditions.

3.1.3 Summary of risks and PPP parties

The three main parties in PPPs possess different goals: the public sector, the private companies, and the lending banks. The public sector is concerned with VfM and efficient public spending, whereas the private sector (i.e. the private companies and the lenders) is profit-oriented. Different players with different objectives have a different perspective on risk. The public sector has a different approach to PPP risk than traditional public procurement. Additionally, the public sector has an 'optimism bias', making it less efficient in the management of most of risks. PPPs bring innovation in the management of risks by separating investment and financing decisions and that public sector only have lower interest rates because the taxpayer´s support losses.

The banks minimise bankruptcy risk and participate in the risk allocation process. Low operational risk reduces the financial costs, which increases the potential to create VfM. However, as the investment and financial decision, in many cases, is not separate, suitable financial conditions often encourage governments to invest in suboptimal projects.

This follows from the fact that the private sector has higher standards concerning investment conditions because the private sector experiences higher default risks and potential losses. Lower project risk can be achieved in two ways: either the company transfers the risks to third parties or the government guarantees a portion of the risk. Therefore, projects can possess high leverage without assuming a high level of risk.

3.2 Risk Allocation

The higher financial costs of the private sector must be compensated for by greater efficiency in operations and risk management to obtain sufficiently high VfM. The optimal risk allocation reduces the economic cost, provides incentive for sound management, and reduces the need for future renegotiation (Asenova & Beck, 2010). A UK survey, (Bing et al., 2005) finds that risk allocation is the first priority for the private sector, whereas it is a secondary priority for the public sector following the overcoming of budgetary constraints.

3.2.1 Risk allocation in the PPP literature

The academic literature considers three risk allocation factors: 1) risk classification, 2) the general allocation of risk, and 3) the allocation of specific risk.

Risk can be categorised in several ways: (i) endogenous versus exogenous risk (exogenous risk cannot be controlled); (ii) commercial risk (allocated preferably to the private sector) versus legal and political risk (usually allocated to the public sector) (OECD, 2008); (iii) development phase risk (planning and construction), the operation and transfer phase risk, and the lifetime phase (political, financial, environmental, and force majeure risks) (Jin, 2010) and, (iv) risks at the macro-, meso- and micro-level (Bing, Akintoye, Edwards, & Hardcastle, 2005b). Macro-level risks are exogenous and are composed of country/industry risk in addition to acts of God. Meso-level risk includes endogenous risk but occurs within project system boundaries such as those concerned with construction, demand, and technology. Micro-level risks are assumed by stakeholders and are party-related (rather than project-related).

Risk allocation complexity arises because the contractual arrangement is achieved through a bargaining process (Medda, 2007). The literature examines whether the risk allocation advantages lead to biased conclusions concerning PPP adoption at the expense of traditional procurement. The criticism is that PPP efficiency is predominantly a result of the pricing of risk in the PSC and from the perceived cost overruns that occur under conventional public investment (Sawyer, 2005). This is discussed in the following subsections.

The majority of PPP risk can be allocated simply: risks can be retained by the public sector, transferred to the private company that manages the PPP (which could opt in turn to reallocate risk to third parties), or shared between public and private parties.

Certain risk is always borne by the public sector (e.g. political risk such as unilateral change in contracts or changes in sector legislation, regulation related to archaeological finds and fossil discoveries, and acts of God). These risks almost always remain with the public sector because they cannot be controlled and could lead to project default. If the private sector were to take responsibility for such risks, it would expect a high financial premium, which would undermine the VfM concept. Other types of risk (related to construction, operations, and maintenance) are always transferred to the private company. This transfer has a minimal level of risk because below this level there is little incentive for private sector efficiency and, therefore, for VfM generation. The allocation of other types of risk such as planning, environmental, demand, and interest rate risk are allocated to other parties and are summarised in Table 1.

Demand risk should be allocated to the private sector for several reasons. Demand risk management requires additional effort and efficiency from the private sector (Chung, Hensher, & Rose, 2010). The private sector understands how to attract users and how to calculate demand elasticity. The private sector is better equipped to accomplish commercial tasks. However, in most PPP projects, this outcome is not possible because the forecast demand will not produce sufficient revenues to make the

project financially viable. The decision to build the PPP is based not only on demand but also on other factors (social, political or environmental, for instance). In the Portuguese experience, we can see how the demand risk was allocated to the private or public side by the type of payment mechanism. In the road sector, there are some PPPs with payments based on levying tolls whereby the private party bears all the traffic risks. However, in all the other road projects, the payments to the private sector are based on availability. This means that as long as the infrastructure is available to be used, the company receives a fixed rent. Therefore, the demand risk in these cases is completely allocated to the public sector.

Because finance risks are economic risks associated with project finance, some researchers believe they should be allocated to the private sector. Interest rate and financial market risk representing project finance economic risk should also be allocated to the private sector. PPPs are essentially a project finance scheme with non-resource debt. This implies that the banks will lend money based solely on the project's future cash flows. Allocating financial risk to the private sector prompts the PPP to pursue sound risk management. Because financing is the greatest cost, the private sector is motivated to minimise it. Finally, the private sector is more familiar and experienced with financial markets than the public sector (Bing et al., 2005b). However, some authors (e.g. Wang, Tiong, Ting, & Ashley (2000 a,b)) consider that traditional public sector borrowing rates are lower than private sector borrowing rates and that this risk should be shared by government guaranteed private sector financing.

[Insert Table 1 here]

3.2.2 Risk allocation in governments reports

Governments view PPP risk allocation as critical for VfM. Some public authorities have created PPP manuals, and Table 2 summarises their perspectives on risk. These manuals provide guidelines and procedures for government departments involved in PPPs and identify the steps necessary to achieve VfM. The guidelines intend to ensure that the PPP process is homogeneous across government departments to enhance transparency and objectivity in PPP management.

The government reports presented in Table 2 identify the risks that should be retained by the public sector, the risks that should be transferred to the private company, and the risks that are subject to negotiation between the private and public sector. The manuals also consider the PSC as a risk adjustment cost. The risks are assessed individually, subjected to sensitivity analyses, and aggregated in NPV terms. Some manuals also contain risk contingency plans and guidelines in case the public sector is forced to reassume risk.

Government efforts to address risk allocation are undermined by the off-balance sheet temptation. Therefore, many PPPs incorrectly allocate risk because the projects must be incorporated into PPPs to avoid fiscal constraints and not because of the process itself. The need to invest through PPPs to avoid budget constraints leads to incorrect risk allocation, which undermines VfM.

[Insert Table 2 here]

3.2.3 Summary of PPP risk allocation

The PPP literature focuses mainly on the risk allocation process. Accurate insight into the various types of risk is central to VfM. The risk allocation process may be misused to exploit PPP advantages over traditional procurement. Without accounting for risk transfer, traditional procurement may appear cheaper than PPPs. The governments that adopt PPPs have developed guidelines for the retention, transfer, and negotiation of risk. Additionally, governments provide risk allocation and valuation guidelines. The next subsection addresses the valuation of risk.

3.3 PPP risk valuation models

PPP risk is similar to traditional project risk. The typical project finance evaluation methods are employed to value PPPs, although each type of risk should be individually evaluated before aggregation with other types of risk. Additionally, each type of risk should undergo a sensitivity analysis to determine the robustness of the forecasts and the business plan.

The combination of both qualitative and quantitative methods (often in combination with a Monte-Carlo analysis) has been proposed for risk valuation (Tanaka, Ishida, Tsutsumi, & Okamoto, 2005)[4]. However, a Monte-Carlo simulation is only appropriate if there is sufficient, quality data, otherwise simple probability methods are sufficient (Grimsey & Lewis, 2005b).

No consensus exists in the literature concerning the optimal discount rate to calculate present value (Sarmento, 2010). Two conflicting theories are apparent: (i) public projects bear minimal risk and require the risk-free discount rate (or a governmental borrowing rate) and, (ii) public projects require a private sector discount rate (Arrow & Lind, 1970; Mehra & Prescott, 1988). Brealey et al. (1997) argue that the discount rate for government projects equals the expected return in the capital markets for comparable investments, that is, the opportunity cost of capital for the private sector. The discount rate can have an overwhelming influence on the NPV. Sarmento (2010) studies seven highway

[4] See Moreno & Navas (2003); Raymar Michael J. (1997); Savvides (1994) for a technical note on the use of this tool and Gatti et al. (2007); Javid & Seneviratne (2000) for the use of Monte-Carlo simulation in PPP risk. For government use of Monte-Carlo simulation see HM Treasury (2003a).

projects and shows that the sum of the NPV of these PPPs drops by more than one billion Euro (from eight billion to under seven billion) if the discount rate augments from 4.5% to 6%.

Academics apply a wide variety of more sophisticated techniques (Table 3) in contrast to the governments who usually stick to simple valuation methods such as discounted cash-flows (see Table 4).

VaR has gained in popularity as it measures the risk of losses in a specific portfolio of financial assets. VaR is defined as the maximum potential loss (given by a certain confidence level, e.g.: 95% or 99%) which faced by a portfolio or financial institution within a certain period. For example, a VaR of a trading portfolio of 50 million in a specific currency at a 99% confidence level implies that there is only one chance in 100, under normal market conditions, that a loss greater than 50 million will occur. This number summarises the portfolio's exposure to market risk, the probability of loss and the level of risk in that specific currency. It also provides an aggregated portfolio risk that accounts for leverage, correlation, and current position. The method can be broadly applied, from market to other types of financial risk (Jorion, 2006). The method is used for risk management, financial control, and reporting.

Some researchers question whether common credit risk evaluation models are suitable for PPPs because of specific project finance characteristics (Esty, 2004). Gatti, Rigamonti, Saita, & Senati (2007) argue that applying VaR to project finance in the same way as traditional corporate financing is not possible. VaR is mainly used for financial portfolios, and PPPs are usually conducted in a non-financial industry context. An alternative is the Cash-Flow at risk (CFaR) approach that assumes uncertain future cash flows and thus a more realistic approach. However, instead of using a single NPV, this approach yields a range of expected values. CFaR represents the cash that would be received or paid from a portfolio of transactions with a likelihood of certainty within a specific time horizon. Earnings-at-risk (EaR) is another approach similar to the CFaR that uses a cash base to estimate earnings and expenditures instead of cash flows and adopts an accrual perspective.

[Insert Table 3 and 4 here]

Sudong & Tiong (2000) developed a new method called NPV-at-risk, which combines the cost of capital, measured by WACC, and dual risk return methods. This method allows the correlation and measuring of risk and return. NPV-at-risk represents the minimum expected NPV at a specific confidence level (e.g. 95%). It involves the determination of the discount rate and the generation of the cumulative distribution of possible NPVs. The authors argue that NPV-at-risk can lead to superior decisions concerning the risk evaluation of infrastructure projects. Other authors (Cheah & Jicai, 2006; Alonso-Conde, Brown, & Rojo-Suarez, 2007; Takashima, Yagi, & Takamori, 2010) introduced the concept of real options in evaluating PPP risk. Real options consist of a proactive approach in managing uncertainty.

Whereas the proposed valuation methods are presented in the academic research, Table 4 shows the valuation methods of governments for PPPs. Governments prefer a qualitative approach based on nominal or descriptive scales that describe the likelihood and consequences of specific types of risk. Traditionally, the public sector has often used a risk probability assessment (to determine the likelihood of a risk occurring) and a risk impact assessment (to determine the potential effect of a risk event) in a straightforward way, possibly because of the public sector's inexperience, lack of knowledge, insufficient data, and complexities in defining risk in terms of likelihood and impact. Broadbent, Gill, & Laughlin (2008), report a recent trend towards more quantitative risk evaluation.

The Australian government uses the CAPM with a discounted cash flow (DCF). The CAPM is a frequently used risk-return model and was independently introduced by Treynor (1961), Sharpe (1964) and Lintner (1965), and builds on the earlier work of Markowitz concerning the diversification and modern portfolio theory further developed by Jensen, Black & Scholes (1972). The CAPM is based on restrictive assumptions concerning transaction costs and asymmetric information. Ross (1976)[5] suggests a different model, the arbitrage pricing model (APM) that offers no arbitrage opportunity. The market risk of any asset is provided by the betas of the factors that affect all investments. The Australian government also applies a risk model using Monte-Carlo simulation.

The UK government sets a risk premium using Monte-Carlo simulation (HM Treasury, 2003a). The fact that the UK government uses a more complex analysis is not necessarily a reflection of more sophisticated or less controversial risk valuation methods because such methods do not appear to capture all of the risk values in the risk transfer.

The South Korean public sector uses the Black-Scholes option pricing model to examine whether the returns to private participants are appropriate for the risks that they bear. A project is valued as an option and the payoff is a function of the value of an underlying asset. The minimum revenue guarantee is interpreted as a private participant put option on the toll revenue, and early termination is a put option on the project. This method enables the public sector to examine and valuate the risk for all parties involved in the PPP. It allows the estimation of fair returns based on the contractual returns of the private participants. The benchmark for the private sector premium is the five-year government bond yield. However, this model requires a complex analysis with additional data requirements and the South Korean government remains in the early stages of the Black-Scholes method.

4. Empirical analyses of PPPs, VfM, and risk

Although PPPs have increased in recent decades, there are doubts concerning their efficiency. Academics and governments have performed studies to examine whether PPPs yield VfM (Hodge & Greve, 2009).

[5] This is developed in (Roll & Ross, 1980).

This section reviews the evaluations of PPP VfM by academics and the public sector (governments and audit court reports) over the last 15 years. We address the last two research questions of this paper: Do PPPs create VfM, and does risk play a fundamental role in VfM generation? The majority of the research that we surveyed concludes that PPPs do not generate sufficient VfM and, therefore, questions their efficiency. Contrastingly, governments and audit courts present a positive picture of PPP VfM.

We searched academic journal databases from the year 2000 and gathered book chapters and studies that were presented at academic conferences. We retained the papers that performed an evaluation of VfM in PPP projects. The research focused on the UK and Australia; therefore, we compare these results with the government information and audit court reports from these two countries.

4.1 Academic case studies

Whether risk plays a fundamental role in VfM generation can be briefly addressed. This is because the majority of academics (as well as the government and audit court reports) are unanimous that risk is the central factor (perhaps the most important factor) in the generation of VfM from PPPs. Whether PPPs create value is considered from a negative perspective by the majority of authors (see Table 5).

[Insert Table 5 and 6 here]

Academics provide five main explanations for the lack of sufficient VfM generation by PPPs (Table 6). First, the private sector assumes limited risk and has thus few incentives to pursue superior management and efficiency. Second, risk is an ambiguous and complex concept with accompanying valuation uncertainty. Third, the methods used to valuate risk are incomplete. Fourth, the PSC favours PPPs because of optimism bias or the use of artificially low discount rates. Finally, PPPs often exhibit VfM only after risk transfer, which closes the gap between the PSC and PPP.

Risk transfer is used to render PPPs an advantageous solution. Several authors conclude that without accounting for risk transfer, traditional procurement or the PSC is cheaper (Pollock, Shaoul, & Vickers, 2002). The efficiency gains from PPPs appear to rely on the pricing of risk transfer or in the expected overrun of costs in the public sector (Sawyer, 2005). Hood, Fraser, & McGarvey (2006) also state that many critics of PPPs have argued that the government has overemphasised the risk that the private sector truly assumes. Ball, Heafey & King (2007) shows that when risk transfers are not considered, VfM is negative. To illustrate why negative VfM occurs, we use the following example. Suppose a PPP faces the PSC cost in NPV terms. This implies that to generate VfM, a PPP should meet the following restriction (in NPV terms):

PPP payments < (PSC cost of construction + PSC operation and maintenance costs + risk transfer to the private sector).

When the risk is transferred to the private sector, the NPV of the PPP payments becomes higher than the NPV of the PSC construction plus the operating and maintenance costs. Most academics conclude that the PPP is an inferior option in public procurement.

The debate is expected to continue, at least until the entire life-cycle of sufficient projects has been studied in detail (Ng & Loosemore, 2007). Many projects remain in the early stages, and VfM can only be properly evaluated over the long term (Nisar, 2007; Weihe, 2008). A greater number of detailed academic studies are required to overcome the gap between theoretical knowledge and practical experience. Academics do not consider PPPs an effective and efficient alternative to traditional procurement, whereas governments reach the opposite conclusion. These varying opinions require further analysis.

4.2 Public sector reports

The public sector perspective concerning PPPs is drawn from government reports and reports from the Court of Audit or National Audit Offices. Governments are an actively involved party, in contrast to academics and audit courts. Therefore, the conclusions drawn from government reports must be considered with caution. Audit courts are independent. They scrutinise government action and decisions to sanction poor decisions by public managers or to provide recommendations for the appropriate use of public resources. We separate the public sector reports in Table 7 into government reports (Panel A) and audit court reports (Panel B). We refer to Table 7 as we attempt to address the last two research questions: Do PPPs generate VfM? Does risk transfer play a key role in VfM generation?

[Insert Table 7 here]

The majority of government reports conclude that PPPs generate VfM. Although most audit court reports reach the same conclusion, they are conservative in concluding that a PPP yields VfM. A cross-country report shows that the UK government appears the most enthusiastic concerning PPP efficiency.

UK government studies (Table 7) cover a range of projects and sectors and compare a PPP with traditional procurement in terms of performance. All four UK government studies that we surveyed concluded that PPPs generate VFM. The conclusion was based on within deadline and budget PPP project delivery, unlike traditional procurement. Governments assess a PPP's efficiency in relation to alternatives and do not state whether a PPP leads to a Pareto optimal solution. Two of the UK government studies were sector specific (public schools) and focused on the significance of risk in generating VfM. Three Australian government studies used the same approach as the UK studies and drew the same conclusion (PPPs are more efficient than traditional procurement). We also examined

13 audit court reports from the UK and four from Australia. These reports raise concern with respect to the efficiency of PPPs. Some PPP projects effectively and efficiently achieve goals, whereas others do not. Thus, overall, the courts have a mixed perspective concerning PPP ability to generate VfM.

The arguments for and against PPPs in public sector reports are listed in Table 8. The main reason for support of PPPs is their efficiency compared to traditional procurement. Efficiency is defined as the timely and within budget delivery of services. Moreover, PPPs deliver the contracted results (although traditional procurement also does so using third-party contractors). The experience curve of the parties involved is another factor encouraging PPP support. Two decades since PPP first emerged, the processes are more efficient because the public and private sectors have gained experience. Finally, PPPs eliminate some risks to public sector. Contrastingly, traditional procurement does not eliminate risk but merely transfers the responsibility to taxpayers. The risks may be less visible, but they are still present.

Arguments exist in opposition of PPPs, some originating from the public sector and especially by the audit courts. VfM depends almost exclusively on risk transfer, and any conclusion concerning VfM is subjective. Some argue that the private sector bears limited risk, whereas the public sector bears more risk than it should. A final argument by the audit courts is that PPP evaluation is not entirely independent, especially when conducted by governments.

[Insert Table 8 here]

The public sector has two arguments in support of PPPs. First, because the public sector is less efficient, building an asset or providing a service using public administration resources is expensive. Second, PPPs reduce uncertainty for public managers because the cost and output are known ex-ante (although this argument may be undermined by potential frequent renegotiations and financial rescues). The main criticism is that PPPs only generate VfM following risk transfer. The VfM, in the calculation of the PSC as opposed to the PPP payments, is the value of the risk transfer that balances the PSC cost in favour of the PPP. Relying on risk transfer to assure VfM is controversial. Andersen (2000) and the UK National Audit Office (2003) state that PPPs, after risk transfer, have exhibited VfM although their conclusions may be biased.[6]

Academics conclude that PPPs do not generate VfM, as shown in 25 out of the 40 papers that we analysed. The remainder is unsure whether PPPs can generate VfM (eleven papers) or are certain that PPPs do yield VfM (four papers). Government researchers, however, mostly conclude that PPPs generate VfM, as shown in six of the seven studies we reviewed (one study was inconclusive). Audit

[6] However, Andersen (2000) study, which is frequently cited in defence of PPPs, has pitfalls. First, Andersen only analyses 7% of the total number of projects (28 out of 400). Second, risk accounts for 60% of total savings. Third, 80% of the savings account for a single project that was run by a company with close ties to Andersen at the time. Therefore, this study should not be relied upon. According to Shaoul (2009), studies by the global consulting firms Price Waterhouse Coopers and KPMG may also be biased towards PPPs because the firms have a vested interest in the projects.(Fouracre et al., 1990).

court researchers are divided; 7 of 17 studies show that PPPs generate VFM, seven do not, and three were inconclusive.

We find that academics and governments agree that risk transfer is central to achieving VfM with respect to PPPs; however, they disagree whether PPPs generate VfM. We discuss the biases from the public and private sector perspectives in the following subsection.

[Insert Table 9 here]

4.3 Study limitations

Academics, governments, and audit courts agree on the critical role of risk in VfM generation; however, their diverging opinions concerning PPP ability to generate VfM are surprising. The divergence is caused by several factors. First, PPP evaluation is complex because evaluations are time specific and, to date, no PPP project has completed the operational phase. Even the oldest PPPs (initiated in the early 1990s) have not yet completed their life-cycle, and most projects have not yet reached maturity. Therefore, it is not possible to evaluate an entire PPP process. Second, government studies are based on a single PPP or country, whereas academic studies involve the study of a larger number of PPPs. Third, the level of experience with PPPs differs according to country: the UK has initiated more than 100 PPPs and Portugal, Spain, and South Korea have initiated more than 40 PPPs each (Araújo & Sutherland, 2010). Other countries are just beginning to use PPPs. Fourth, benchmark studies on traditional public procurement are required to evaluate PPPs, but limited research exists on this topic (with the exception of Fouracre, Allport, & Thompson (1990); Pickrell (1990); Flyvbjerg, Holm & Buhl (2002)). This gap in the literature adds complexity to the measuring of public sector inefficiency and its comparison with the real cost of PPPs. Fifth, academic studies suffer from limited data, whereas government agencies have access to richer data (Hodge & Greve, 2009). Sixth, some studies mix the investment decision with the finance decision. There are cases where governments identify assets to be built using limited economic or social rationality. Seventh, academic evaluations may be more objective with an independent viewpoint (known as the arm´s length principle for PPPs (Boardman & Vining, 2010) compared to governments and even audit courts (that tend to focus on legal issues rather than performance). Additionally, academics use superior valuation methods than the public sector. Eighth, government analysis and risk management may be subject to optimism bias that can cause the public sector to be vulnerable to risk.

4.4 A cross-country comparison: the UK and Australian experience

The majority of PPP studies originate from the UK or Australia. Although these studies address different project types (e.g. schools, prisons, health care institutions), some are comparable in terms of scope (Panel A, Table 10). These studies differ in terms of methodology (Panel B of Table 10). Government studies compare traditional procurement costs with those of PPPs, or the real and estimated PPP costs of the base case, whereas academic researchers base their findings on case-studies and surveys.

[Insert Table 10 here]

The UK studies by Macdonald (2002) and the National Audit Office (2003) that compare the PSC (or the real cost to the public sector) to PPP cost, conclude that VfM has been generated. Studies for Australia by Group (2007) and Forum (2008) find similar results. A UK study on PPPs for schools that was based on surveys of the project stakeholders also shows VfM.

These government findings may be biased because they reflect individual perceptions, which may focus on quality and availability and not on costs and risk transfer. These studies compare the present solution (PPPs) with that of the past (public procurement), but do not compare PPPs with the most efficient theory, model, or existing solution.

Shaoul (2005) presents a VfM methodology for the UK health sector that determines the risk transfer and compares the cost of the PSC with PPPs. The study concludes that PPPs are more costly than the PSC before risk transfer. The author shows that VfM was based solely on risk transfer (a vague and subjective basis). The National Audit Office (2010b) compares the real costs with the estimated, original contract costs for the health sector, but this analysis does not study VfM, unless the original contracts themselves have shown VfM.

Group (2007) and Forum (2008) conducted comprehensive studies in Australia on PPP projects by comparing the costs between PPPs and public procurement. The assessment on PPP VfM is positive, and the studies show that public investment is more costly with time and budget overruns. Contrastingly, English (2003) reviews performance audits in Australia and finds that PPPs do not generate VfM. The different methods used in these studies make the results difficult to compare. Only a few audit reports used in English (2003; 2007) work are available and are based on the pre-contracting stage. The reports focus on the performance of the contract benchmark with best practices. The audits do not compare the alternative public sector 'state of the art'. It should be noted that the conclusions of these government reports and English (2003) is not totally contradictory: The studies concludes that PPPs do not perform well, but (Forum, 2008; Group, 2007) conclude that they perform better than traditional procurement. PPPs can underperform and still be a better solution than traditional procurement. However, we cannot draw a definite conclusion for the Australian case based on our review.

We find diverging distinctions among the conclusions in the 64 studies reviewed. Overall, academics are sceptical concerning PPP ability to generate VfM, whereas governments and audit courts are more confident concerning PPP efficiency.

5. Conclusions

Governments use PPPs for two purposes: to remove public investments from the balance-sheet and to generate VfM. A PPP creates VfM when it provides the same level of service quality and quantity at a lower overall cost than traditional public sector procurement. Because private sector financial costs are traditionally higher than those of the public sector, PPPs face a financial disadvantage. Therefore, VfM from PPPs must originate from greater efficiency provided by the private sector, an efficiency that must compensate for the sector´s higher financial costs. The private sector is more efficient because there are built-in, performance-oriented incentives and economies of scale. PPP efficiency is a result of investment and operational cost and superior risk management.

This study addressed four research questions: (i) How should risk be allocated in PPPs? (ii) How should risk be valued? (iii) Do PPPs create VfM? (iv) Is risk essential for value creation?

With respect to the first question, we find that risk is crucial for VfM. Although the three main parties in a PPP (the government, the company, and the bank as lender) possess their own objectives, the three parties must be aligned concerning the allocation of risk. Academic researchers express concern for risk allocation, and some consider that VfM is used to make PPPs appear more advantageous. However, governments focus on providing guidelines to public departments concerning risk allocation.

With respect to the second question, we document that the public sector usually adopts simple valuation tools that are often based on a qualitative approach. Contrastingly, academics usually employ methodologies such as VaR, NPV-at-risk, CFaR, and real options. NPV-at-risk and CFaR are appropriate to apply in a PPP context. However, the academic literature on this issue is limited only in terms of quantity and because existing studies use only one technique or consider a single project.

To answer the third and fourth questions, we examined PPP evaluation by academics, governments, and audit courts. We examined the paper, government report, and audit report conclusions in terms of VfM generation and risk management. All parties provide a positive answer to the fourth question; however, they report diverging conclusions for the third. Academics are sceptical concerning PPP ability for VfM generation, whereas governments are not. Academic scepticism (related to risk transfer) is based on the following. First, the PSC favours PPPs because PPPs only generate VfM following risk transfer. The private sector bears limited risk and risk valuation is an ambiguous

concept. The public sector claims that PPPs create VfM because they are more efficient than the alternative public procurement and because PPPs reduce uncertainty.

All the studies we reviewed, however, have several limitations. First, PPPs are a convoluted system involving different parts and specific technicalities. Additionally, PPPs worldwide are either incomplete or have not yet reached maturity. Second, studies are based on a single PPP or country. This is an important issue because the PPP experience differs substantially according to country. Finally, studies lack objectivity and data.

Are the results we found contradictory? Somehow yes, but limitations, different methodologies, and a lack of meta-analysis causes conclusions that are vague and imprecise. Therefore, additional country studies with complete methodologies, risk evaluation tools, a greater number of projects, richer data, and longer study periods are required. Further research can clarify PPP ability to generate VfM and their degree of efficiency using public resources.

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Figure 1 - PPP and public debt

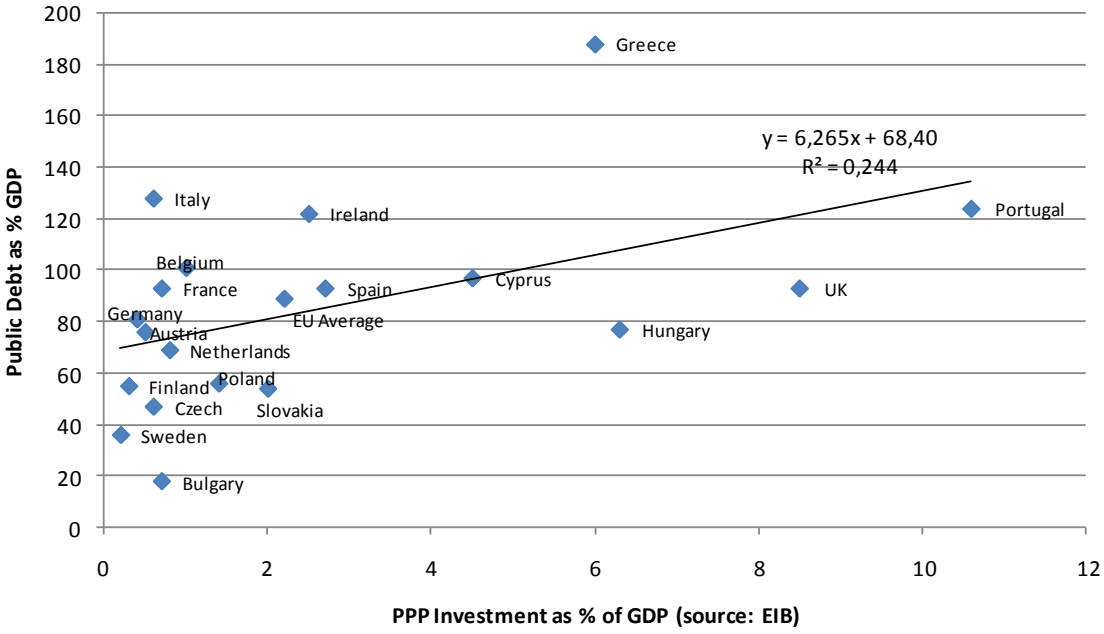

Figure 2 – Evolution of Portuguese sovereign bonds 10 years and PPP cost of debt

This graph shows the evolution of the risk free rate in Portugal (measured by the yield to maturity in the secondary market of the 10 years Portuguese government bonds) versus the average cost of debt of the Portuguese PPPs. Source: own calculations.

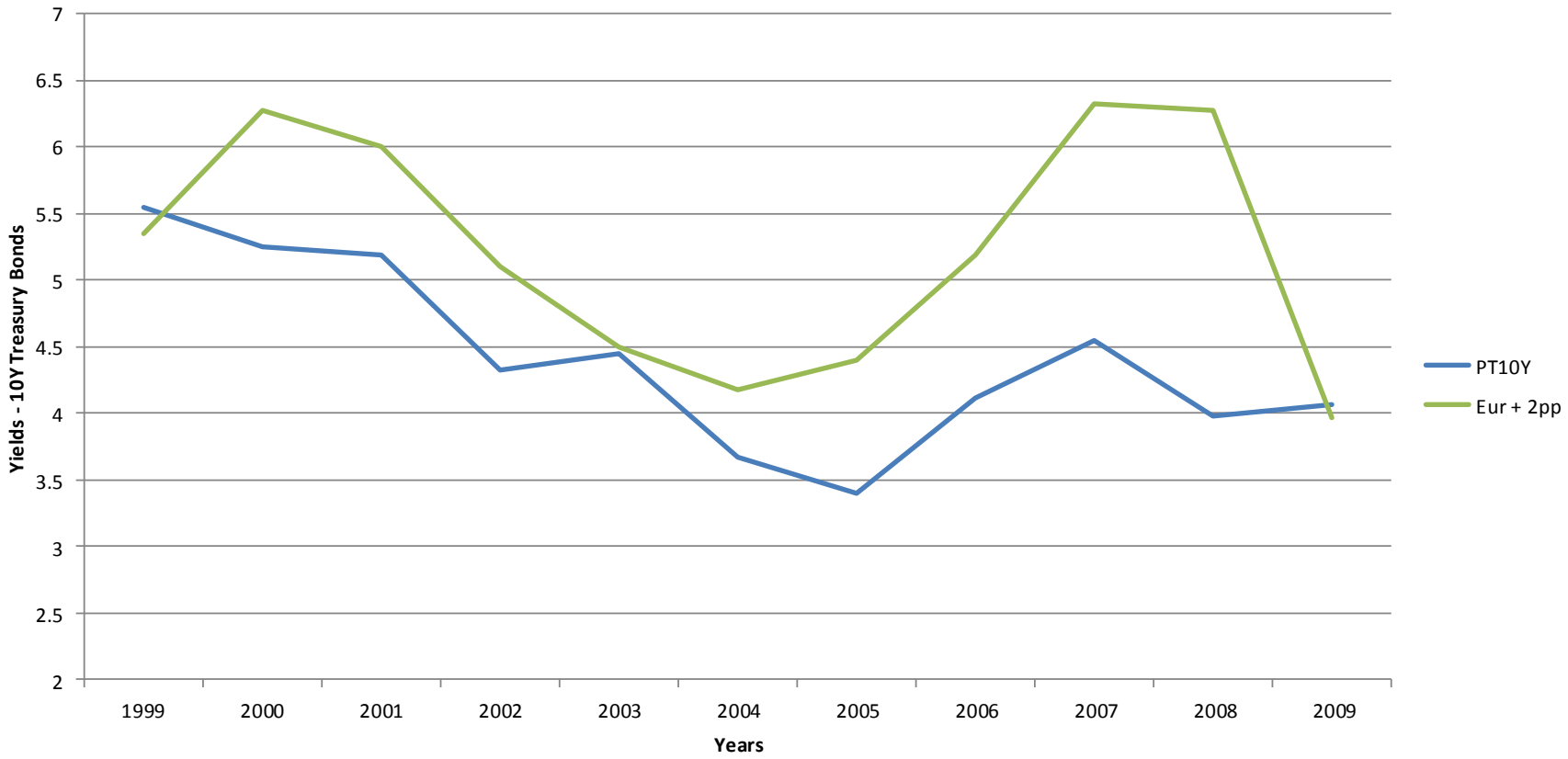

Table 1 – Allocation of different types of risk

This table summarises the literature on how risks are allocated. Planning risks: risks related with the conceptualisation and implementation of the project; Environmental risks: risks related to environmental regulations and approvals; Demand risks: risks related with insufficient demand, which is necessary to profitability; Finance risks: risks related with the financing of the CAPEX and which mainly changes with the interest rate. Source: own table.

Type of Risks	Literature favouring risk allocation to the Public Sector	Literature favouring shared risk allocation	Literature favouring risk allocation to the Private Sector
Planning	Bing, Akintoye, Edwards, & Hardcastle (2005a)	Ng & Loosemore (2007)	Lam, Wang, Lee, & Tsang (2007)
Environmental	Lewis (2001)	Bing et al. (2005a)	Ng & Loosemore (2007) Lam et al. (2007)
Demand	----------	Arndt (1999)	Wang, Tiong, Ting, Ashley (2000,a,b) Lewis (2001) Bing et al. (2005a) Grimsey & Lewis (2005b) Ng & Loosemore (2007) Chung et al. (2010)
Finance	----------	Wang, Tiong, Ting & Ashley (2000, a,bc) Lewis (2001) Ng & Loosemore (2007)	Bing et al. (2005a) Chung et al. (2010) Grimsey & Lewis (2005b)

Table 2 – Risk allocation in governmental reports

This table presents the main guidelines that governments (of Australia, Canada, New Zealand, and United Kingdom) use to allocate risks in PPP. PSC and VfM stand for public sector comparator and Value for Money, respectively. Source: own table.

Report	Country	Year	Main guidelines
(Scotia, 1997) Transferring Risks in PPP	Canada	1997	• Risk is divided in four categories: Ownership; Operational; Financial and "Acts of God" • Guidelines about strategies to allocate risks (must be objective and clearly evaluated)
(NAO) - Examining the value for money of deals under the Private Finance Initiative	UK	2000	• Description of several risk categories and to whom they should be allocated • Each project has its own specification
(Treasury) The Government´s Approach	UK	2000	• Clear differentiation between private sector responsibilities and remaining public sector accountability • Contractor is only exposed to financial penalties for his own performance
(Victoria) Partnerships Victoria: Guidance material Overview	Australia	2001	• Private party should bear risks related to designing, building, and operating the infrastructure, including the risk of obsolescence and/or residual value • VfM: government should retain the risks which they can manage efficiently • Specific government-preferred approaches for each type of risk (10 major categories) • How to price risks
(Canada) Public-Private Partnerships: A Canadian Guide	Canada	2001	• Potential risks associated with PPPs • Governments can reduce or eliminate these risks through negotiations and contractual arrangements • The costs that these risks represent must be factored into the PSC model • It is important to consider the financial strength of the parties to whom risks are allocated
(Victoria) Partnerships Victoria: PSC Supplementary Technical Note	Australia	2003	• Risk allocation guide • PSC includes a valuation of transferable and retained risks
(Canada) The Public Sector Comparator: A Canadian Best Practices Guide	Canada	2003	• PSC is a risk-adjusted costing • Each type of risk should be aggregated to determine the NPV of the transferable risk component of the PSC • Each type of risk should be included as a separate cash flow item, for a detailed analysis and their sensitivity
(Canada) P3 Public Sector Readiness Assessment Guide	Canada	2003	• Public sector must develop a contingency plans for mitigating risk • All risks should be identified in an appropriate matrix • Optimum allocation should be identified
(Treasury) PFI – Meeting the Investment Challenge	UK	2003	• Transfer only those risks which the private sector can more effectively and efficiently manage
(Treasury) The Orange Book	UK	2004	• Aims at an optimum response to risk • Prioritizes risks based on an evaluation • Establishes a principle of risk management, and the "Risk Management Assessment Framework"

Report	Country	Year	Main guidelines
(Treasury) and (Treasury) Quantitative Assessment User Guide	UK	2004 and 2007	• Standard mandatory spread sheet for the VfM assessment, with a proposed testable risk management approach • Identifies all relevant risks, irrespective of which party has responsibility for managing the risk • Identifies which party is best placed to manage each risk
(Treasury) PFI: strengthening long-term partnerships	UK	2006	• Setting out further improvements to PPP to support their ongoing important role in delivering better public services • Defines risks to be transferred to private and to be retained by public sector
(Treasury) VfM Assessment Guide	UK	2006	• Optimum allocation of risks is one of the main key drivers for VfM • The transfer or risks goal is to incentive private sector efficiency and VfM
(Treasury) How to manage the delivery of long-term PFI contracts	New Zealand	2007	• Contingent plans for the public sector in case of reassuming risks previously allocated to the private sector
(Treasury) Standardization of PFI Contracts Version 4	UK	2007	• Promotes a common understanding of the main risks encountered in a standard PPP project
(4P`s, 2007) A guide to contract management for PFI and PPP projects	UK	2007	• Risks and levels of deductions must be clearly understood by all parties • Systems and methodologies should be in place to mitigate operational risks • Risks should be reviewed at all stages of the process
(Treasury) Guidance for Public Private Partnerships in New Zealand	New Zealand	2009	• Government has to evaluate benefits, risks, and costs of the preferred option against other options • PSC includes an estimation for any additional costs and for risks that would be transferred to the private sector partner under a PPP • Risk allocation matrix must be developed, all risks should be considered, and no unintended effects should arise
(4P´s, 2009) 4P´s: developing public private partnerships in housing	UK	2009	• Summary analysis of risks and benefits of PPP, particularly in the housing sector programme

Table 3 - Risk models valuation

This table presents the risk valuation models used in PPP in the literature. DEA: Data envelopment analysis; DCF: Discounted cash-flows; WACC: Weighted average cost of capital.Source: own table.

MODEL	AUTHORS	CHARACTHERISTICS	ADVANTAGES	DISADVANTAGES	MAIN CONCLUSIONS
Value at Risk	Gatti et al. (2007) Li, (2008) Hanli, ChaoQun, Bo, & Tao (2009)	Specific VaR (with Monte-Carlo simulation) for project finance specifications	• Calculates the default risk of a PPP project • Recognises different levels of complexity of project • More precise in risk-adjusted pricing	• Quantity and quality data required • Need to checking the model structure and the key indicators • Difficult to precisely estimate the distribution of parameters in the model precisely	• Suited for estimating project risks for sponsors and lenders • Method that simplify PPP complexity
NPV at Risk	Sudong & Tiong, (2000)	Combines WACC with dual risk methods	• Leads to a better decision in risk valuation than traditional methods like CAPM	• Complex • Quantity and quality data required	• NPV at risk represents a more vigorous investment decision method
Cash-Flow at Risk	LaGattuta, Stein, Tennican, Usher, & Youngen (2000)	Simulates cash-flow risk by Monte-Carlo simulation	• More appropriate for projects than VaR	• Requires calculating a probability distribution for future cash-flows	• Quantifies differences in the cash-flows related to the project risks
Credit scoring model	Cheng, Chiang, & Tang (2007)	Calculate the credit scoring model of a PPP by DEA	• DEA is more objective • Used in several types of financial loans, not just PPP	• Only applies to credit scoring. • Valid only for financial risk	• Appropriate because PPP relies strongly on debt financed by banks
Real Options	Cheah & Jicai, (2006) Alonso-Conde et al. (2007) Takashima et al., (2010)	Subsidies and guarantees represent a form of options and all options have value Real options provide a framework for valuating these guarantees	• Flexibility of this approach • More accurate valuation of guarantees and risks in a PPP	• Use of DCF with a single risk-adjusted discount rate is problematic • No multiple PPP cases in a single study • Complexity of the analysis.	• Options can be evaluated with a Monte-Carlo simulation for a DCF model

Table 4 - Valuation risk models used by governments

This table shows the different valuation models used by governments to valuate risks in PPP. Source: own table.

VALUATION MODEL	COUNTRY	OFFICIAL DOCUMENT	CHARACTHERISTICS	ADVANTAGES	DISADVANTAGES	MAIN CONCLUSIONS
CAPM using DCF analysis	Australia	Victoria (2003b)	Risk is considered in the discount rate	Simple risk valuation	Discount rate must be calculated for each project	Depends on the accuracy of forecast of cash-flows and estimation of discount rates
Risk premium with Monte-Carlo simulation	UK	Treasury (2003a)	Adds a risk premium to provide the value of base case, in order to adjust for the "optimist bias".	More complex and detailed analysis than other governments guidelines	Requires more data and more specialized staff	Add a risk premium to provide the full expected value of the base case Is a good practice
Risk modeling with Monte-Carlo simulation	Australia	Victoria (2003a)	Uses probability distribution of input variables	Risk allocation guide.	Only possible if sufficient data are available	Technique depends on significance of the project and complexity of the risks
Black-Scholes Option Pricing Model	South Korea	ADB (2011)	Examines the level of returns to private parties in comparison with the risks that they bear Minimum Revenue Guarantee is a private sector put option on toll revenue, and early termination is a put option on the project Government's redemption right is a call option on toll revenue and early termination is a call option on the project	Valuate risks for all PPP participants More complex and detailed analysis than other governments guidelines	Complex analysis Data requirements	Estimation of appropriate return has steps: (i) estimation of base case fair return and (ii) adjustment for option values such as minimum revenue guarantee or redemption right of government.

Table 5 - Academic studies on Value for Money and Risk in PPPs

This table summarizes the academic findings regarding VfM and Risk in PPP projects. Column "VfM" indicates whether the PPP yields VfM: Y indicates that VfM is positive; N indicates that VfM is negative; N/D indicates that it could not be determined whether VfM is positive. The column 'Risk crucial to VfM?'" shows whether risk as an indispensable issue for ensuring VfM in PPPs (Y=yes, N=no). CSF = Critical success factors; PSC= Public sector comparator; VfM= Value for Money. Source: own table.

AUTHOR	YEAR	COUNTRY	Type of PPP	VfM	RISK CRUCIAL TO VfM?	CONCLUSIONS
Ball	2000	UK	High School projects	N	Y	• VfM remains uncertain • Risk valuation has uncertainties, making risk transfer unreliable • Risk transfer may not be as significant as the public sector claims
Froud & Shaoul	2001	UK	NHS Hospitals	N	Y	• Risk transfer is main justification for PPP and is central to VfM • Interest rate paid by private sector suggests that banks consider PPPs low risk • Limited evidence on risk transfer
McCabe	2001	UK	Schools	N	Y	• Concerns about quantification of risk transfer and cost calculation, which questions validation of PSC and VfM • Doubts over selectivity in transferred risks, methods used to calculate risk-related costs, and the fact that the public sector assumes all demand risks • Confirms questions raised by previous studies over robustness and subjective nature of evidence used to substantiate VfM in PPPs
Pollock	2002	UK	6 Hospitals	N	Y	• VfM assessment is skewed in favour of private sector • VfM is only shown after risk transfer • NPV of PSC is lower than PPP before risk transfer • No method for valuating risks
Pollitt	2002	UK	10 PPP projects	Y	Y	• PPP is successful in the UK, compared with traditional procurement • PPPs save time and money, promote innovation and efficiently allocate risks
Shaoul	2002	UK	PPP London Underground	N	Y	• Project was not affordable, since private sector does not assume risks, relying on public guarantees
English	2003	Australia	Overall projects	N	Y	• Evidence that governments are not as successful as private-sector in identifying and shifting risk and, therefore, at achieving VfM
Edwards	2004	UK	8 Roads and 13 hospitals	N/D	Y	• Allocation of risk among partners may be unclear and therefore so is its transfer Additional monitoring costs have increased public sector's costs and thus reduced VfM compared with original expectations

AUTHOR	YEAR	COUNTRY	Type of PPP	VfM	RISK CRUCIAL TO VfM?	CONCLUSIONS
Fitzgerald	2004	Australia	8 projects	N/D	Y	• Risk evaluation process needs to be improved • Need more evidence of frequency and a large sample of risks events • Public sector should use a discount rate that does not incorporate a premium risk
Hodge	2004	Australia	Roads infrastructure	N/D	Y	• Investigates risk transfer • Outlines empirical experience on transfer of risks
Bing et al.	2005	UK	Construction projects	N/D	Y	• Examines, through a questionnaire, the importance of 18 CSFs for PPP • Finds risk allocation and sharing are relevant CSFs
Hodge	2005	Australia	Overall projects	N/D	Y	• Few available assessments suggest varied performance • No rigorous and transparent evaluations of all Australian PPPs
Pollitt	2005	UK	Overall projects	Y	Y	• Positive overall assessment
Shaoul	2005	UK	Health sector	N	Y	• Risk transfer is an ambiguous concept • Uses ex-ante risk transfer to close gap between public and private options, to ensure preference is given to PPP • Instead of demonstrating risk transfer, business case simply asserts what they intended to prove
Pollock	2005	UK	5 government commissioned studies	N	Y	• Up to 24% of PPPs have 'optimism bias' in risk adjustment • Studies fail to present sound data-based proof for addressing time and costs overruns
Dixon	2005	UK	Case-studies	N/D	Y	• VfM and risk transfer are key to success • High procurement and transaction costs, and large-scale nature of PPPs are barriers to entry
Boardman	2005	USA	Private toll road case	N	Y	• PPPs incur significant losses, even after refinancing and tax benefits
Shaoul, Stafford, & Stapleton	2006	UK	8 Highway projects	N	Y	• Risk transfer is critical to PPP VfM • Most risk transfers are related to construction risks. But after construction phase, it is not clear what other risks, beside operational ones, the private sector accounts for • Risk transfer is very expensive
Blanc-Brude	2006	Europe	65 PPP across 15 EU countries	N/D	Y	• Ex-ante construction costs of PPPs are 24% higher than traditional procurement • Whether PPPs have lower overall life-cycle costs remains unknown

AUTHOR	YEAR	COUNTRY	Type of PPP	VfM	RISK CRUCIAL TO VfM?	CONCLUSIONS
Darvish	2006	Australia	2 PPP: Tunnel and Airport	N	Y	• VfM and private sector profits in PPPs are only viable through optimal risk allocation and balance of interests between public and private sectors
English	2007	Australia	Overall projects	N	Y	• Australia's audit offices largely fail to independently scrutinise PPP • High premium in transferring risks to private sector
Pollock, Price, & Player	2007	UK	11 PPP projects	N	Y	• No evidence of improved efficiency in PPP • The Treasury "Green book" is biased towards PPPs
Ng & Loosemore	2007	Australia	Railway project	N	Y	• Government assumes most of the risks. • Provides useful recommendations for better risk management • Shows complexity and obscurity of risks in PPPs and difficulties in distributing such risks appropriately
Chung	2007	Australia	Hospital project	N	Y	• Government fails to ensure that financing is channelled through appropriate risk sharing arrangements. It fails to make private sector accountable for required level of quality
Ball	2007	UK	School projects	N	Y	• Suggests a significant problem with VfM in PPP projects • VfM and economic viability of projects depend entirely on transfer of risk in 9 of 11 projects • Highlights problems with risk transfer • 2/3 of risk transfer regards construction and quality. Inaccurate risk transfer lead to different results in VfM • Without risk transfer, 5 projects would have had a lower VfM by more than 10%
Nisar	2007	UK	5 cases: Prison, hospital, bridge and military	N	Y	• Evidence is balanced on PPP effectiveness • More emphasis needs to be placed on strategies for transfer of risk for successful conclusion of PPP contracts
Chan	2008	Australia	Bridge project	N	Y	• Improper allocation of risks could affect success of PPP • Project failed due to fact that Government managed to pass on many of the project risks to private sector
Barlow & Köberle-Gaiser	2008	UK	6 hospitals	N	Y	• PPPs increase complexity between project delivery and hospital operational functions • Inefficient allocation of risks hinders innovation • PPPs do not automatically lead to efficiency and innovation benefits

AUTHOR	YEAR	COUNTRY	Type of PPP	VfM	RISK CRUCIAL TO VfM?	CONCLUSIONS
Broadbent et al.	2008	UK	17 Health PPPs	N	Y	• Risk estimation is central in decision making • Dominance in "accounting logic" • Quantitative analysis and recognising uncertainty are important
Andrew	2009	Australia	Prisons	N	Y	• Cost data are not an adequate basis for policy decisions
Tallman	2010	Canada	Overall projects	N	Y	• In over half of the cases, risks are identified through formal mechanisms, but few quantify risks • Less than half of the cases show VfM generation. Half of the cases do not evaluate VfM.
Cuthbert & Cuthbert	2010	UK	Health project	N	Y	• NPV of PSC is inflated because of misallocation ascribing of risks and costs. • Decision was biased in PPP favour
Demirag & Khadaroo	2010	UK	School projects	Y	Y	• Evaluates VfM Ex-post and impact of project size in VfM • Teachers are satisfied with the outcomes overall, more so in small projects
Demirag, Khadaroo, Stapleton, & Stevenson	2010	UK and Scotland	Overall projects with 6 case-studies	N/D	Y	• Risks transferred from public sector are dispersed amongst multiple entities. This dispersion of risks adds cost, raising questions about VfM
Sarmento	2010	Portugal	PPP roads	N	Y	• PSC considerably below PPP payments • PPPs only show VfM if public sector has high levels of inefficiency
Ball	2011	Australia and UK	Overall projects	ND	Y	• In the UK there are doubts about the validity of the VfM analysis, even the NAO ones. • In Australia some analysis conclude that some projects did not show VfM • In most cases is the risk transfer element that provides the PPP with VfM
Maqsood, Khalfan, & Aranda-Mena	2012	Australia	Overall projects	Y	Y	• PPPs show VfM especially in large and complex projects, due to risk transfer
Haughton & Mcmanus	2012	Australia	Tunnel project	N	Y	• This project failed to deliver most of its objectives.
Barlow, Roehrich, & Wright	2013	Europe	Health	N/D	Y	• Results are mixed: older PPPs did not show effectiveness, as new models show better opportunities for gains, but are harder to set up and manage

Table 6 - Main criticism on VfM in PPP

This table summarizes the main criticisms in the literature regarding VfM in PPPs.
PSC: Public sector comparator; VfM: Value for Money.
Source: own table.

Main Points	Main ideas	Authors
Private sector risks	• Private sector assumes few risks and therefore has little incentive to perform better and be more efficient	Ball (2000); Froud & Shaoul (2001); Shaoul (2002); Shaoul et al. (2006); Ng & Loosemore (2007).
Risk concepts	• Risk is an ambiguous concept • Risk is complex • Risk valuation is uncertain	Ball (2000); Shaoul (2005); Ng & Loosemore (2007); Broadbent et al. (2008)
Risk valuation	• No methods or simple methods used	McCabe (2001); Pollock (2002); Fitzgerald (2004); Tallman (2010)
PSC	• PSC is biased in favour of PPP • Optimist bias • Discount rate used in PSC favours PPPs	Pollock (2002); Pollock (2005); Pollock et al. (2007); Shaoul (2005); Sarmento (2010)
Risks and VfM	• Risk transfer is used to close the gap between PSC and PPP • PPP only show VfM after risk transfer	Froud & Shaoul (2001); Pollock (2002); Shaoul (2005); Ball (2007)

Table 7 - Public sector reports on Value of Money and Risk in PPPs

Panel A summarizes government reports on PPP whereas Panel B shows Courts of Audit reports. Both panels evaluate PPPs' VfM and the role of risk in achieving VfM. Column VfM indicates whether Value for Money is obtained (Y=yes; N= No; N/D=unable to determine VfM. Column "Risk crucial to VfM?" shows if the study considers risk as an indispensable issue for ensuring VfM in PPPs. CSF= Critical success factors; PSC= Public sector comparator; VfM= Value for Money. Source: own table.

PANEL A – GOVERNMENT REPORTS

AUTHOR	YEAR	COUNTRY	PPP ANALYZED	VfM	RISK CRUCIAL TO VfM?	CONCLUSIONS
Andersen	2000	UK	29 projects	Y	Y	• Risk is the main driver (out of 6) of VfM • Cost savings amount to 17% relative to traditional procurement, but most of these savings are explained by 2 very successful PPPs
MacDonald	2002	UK	11 PPP vs 39 public projects	Y	Y	• PPPs deliver late in 24% of cases and overestimated cost in 22% • Public projects deliver late in 70% of cases and overestimated cost in 73%
Commission	2003	UK	Schools	Y	Y	• Economic viability and VfM in all PPP schools depend on risk transfer
VPAEC	2006	Australia	Overall projects	N/D	Y	• Limited independent external scrutiny of PPP to date • Inadequate independent oversight (in quality and quantity); Inconclusive on PPPs ability to transfer risk, achieve VfM and savings, and other program objectives
Group	2007	Australia	21 PPP projects vs 33 public	Y	Y	• PPPs clearly demonstrate greater cost efficiency than traditional procurement • Traditional procurement does not eliminate risks, only transfers them to taxpayers
Forum	2008	Australia	PPP projects vs traditional procurement	Y	y	• In 35% of the cases, PPPs perform better than traditional procurement • PPPs have average cost escalation of 4.3%, compared to 18% for traditional projects • During construction, average delay for PPPs is 2.6%, and for traditional procurement 25.9%
CCPPP	2010	UK	Schools	Y	Y	• Appropriate risk allocation assists efficient operation

PANEL B – COURTs OF AUDIT REPORTS

AUTHOR	YEAR	COUNTRY	PPP ANALYZED	VfM	RISK CRUCIAL TO VfM?	CONCLUSIONS
NAO	2003	UK	38 PPPs vs 37 public projects	Y	Y	• PPP deliver on time in 76% of cases and within budget in 78% • Public projects deliver on time in only 30% of cases and within budget in only 27%
NAO	2004 a)	UK	London underground	N/D	Y	• Inconclusive on performance assessment against contractual benchmarks • Public sector needs to follow best practices in risk management
NAO	2004 b)	UK	London underground	N/D	Y	• Limited assurance that risk valuation is credible • High rate of return for the risks assumed
NAO	2006	UK	Paddington Hospital	N	Y	• Large number and scale of risks is one of three main reasons for project's failure • Significant risks, due to complexity and timescale (that lead to specific additional project and political risks)
Auditor-General	2006a	Australia	Schools	Y	Y	• VfM is achieved with risk transfer • Savings between PPP and PSC are due to valuation of risk transfer to private sector
Auditor-General	2006b	Australia	Tunnel project	N/D	Y	• Inconclusive on whether PPP generates VfM
Auditor-General	2007	Australia	2 major PPP projects	Y	Y	• Risk allocation is reasonable • Projects are well managed and effective
NAO	2009 a)	UK	Defence PPP projects	Y	Y	• Effective risk allocation and management is particularly important to delivering VfM in PPP contracts • Most risks are well managed • In nine out of ten examined risk categories, there was either low or moderate risk in private sector • Six of eight case studies show VfM

AUTHOR	YEAR	COUNTRY	PPP ANALYZED	VfM	RISK CRUCIAL TO VfM?	CONCLUSIONS
NAO	2009 e)	UK	Overall PPP	Y	Y	• PPPs usually deliver what was contracted. They also successfully transfer risks • Risk transfer depends on contracts • Few PPPs fail
NAO	2009 d)	UK	Construction performance	Y	Y	• PPPs were delivered on time and within budget in two thirds of the time • Public projects were delivered on time in two thirds of the cases and within budget in half of the cases
NAO	2009 b)	UK	Schools	N/D	Y	• Inconclusive regarding VfM • Achieving VfM requires cost savings in long-run
NAO	2009 c)	UK	Municipal waste	N/D	Y	• VfM depend if PPP meet the expected targets
NAO	2010 a)	UK	Overall PPP: 162 projects	N	Y	• No clear data to conclude whether PPPs have led to demonstrably better or worse VfM than other forms of procurement • Insufficient data on returns to equity investors for the risks they bear • Due to financial crisis, PPPs may no longer be as efficient as they were in the past
NAO	2010 c)	UK	Housing sector	N/D	Y	• Housing is one of the more complex PPP sectors due to the specific risks (construction and tenants) • More comparative assessment of VfM and risks is necessary
NAO	2010 b)	UK	Hospital	Y	Y	• Most contracts perform satisfactorily or better than expected • Inconclusive about whether PPPs generate VfM better by including hotel services in contracts
Auditor-General	2010	Australia	Prisons	N	Y	• Appropriate management of the allocated risks is necessary to avoid deterioration in the VfM
NAO	2012	UK	Equity capital in PPP	N/D	Y	• Private investors bear some but very limited risks. • Public sector has relied on competition to seek efficient contract pricing, without information about the PSC cost • Concern that public sector is paying more than it should for equity investment

Table 8 –PPPs in government's reports

This table summarizes the main arguments for and against PPPs, according to the government and courts of audit reports included in Table 5 and 7.
VfM: Value for Money
Source: own table.

Arguments in favour	Arguments against
PPPs reduce cost and time deviations	VfM depends entirely on risk transfer Yet, risk transfer is subjective and difficult to measure
PPPs deliver what was contracted	Low/inadequate risk transfer
Few PPPs fail and most perform well	Public sector could be paying more than it should
With time and experience, PPPs become more efficient, and private sector returns decrease (in early PPPs, the private sector gained excessive returns)	Not all projects should be conducted as a PPP
Traditional procurement does not eliminate risks, but only transfer them to taxpayers	Evaluations are not independent enough
	More and better studies and evaluations are required
	Insufficient data

Table 9 - Value for Money in PPPs

This table presents the results on VfM from academic studies, government reports and Courts of Audit reports. Information is presented by the number of studies/reports by evaluation outcome (Y – show VfM; N – Not show VfM, N/D- VfM not determined). Source: own table.

Academic Studies				
		VfM?		
Country	**Nº Studies**	**YES**	**NO**	**N/D**
UK	22 (55%)	3 (7.5%)	14 (35%)	5 (12.5%)
Australia	13 (32.5%)	1 (2.5%)	8 (20%)	4 (10%)
Canada	1 (2.5%)	0	1 (2.5%)	0
Europe	2 (5%)	0	0	2 (5%)
Portugal	1 (2.5%)	0	1 (2.5%)	0
USA	1 (2.5%)	0	1 (2.5%)	0
TOTAL	**40**	**4 (10%)**	**25 (62.5%)**	**11 (27.5%)**

Government reports				
		VfM?		
Country	**Nº Studies**	**YES**	**NO**	**N/D**
UK	4 (40%)	4 (40%)	0	0
Australia	3 (30%)	2 (20%)	0	1 (20%)
TOTAL	**7**	**6 (86%)**	**0**	**1 (14%)**

Courts of Audit reports				
		VfM?		
Country	**Nº Studies**	**YES**	**NO**	**N/D – N/A**
UK	13 (76%)	5 (29%)	2 (12%)	6 (35%)
Australia	4 (24%)	2 (12%)	1 (6%)	1 (6%)
TOTAL	**17**	**7 (41%)**	**3 (18%)**	**7 (41%)**

Table 10 –The UK and Australian PPP experience

This table shows an overview of PPP studies by country and type of projects and highlights the studies which demonstrate that VfM was generated and those which cannot. The table limits to studies to those on the UK and Australia. BC: Business Case; NAO: National Audit Office (UK); PSC: Public Sector Comparator. Source: own table.

Panel A: Comparable studies on VfM by country and type of project			
COUNTRY	PPP PROJECT	STUDIES THAT SHOW VfM	STUDIES THAT DID NOT SHOW VfM
Australia	Overall projects	Group (2007) Forum (2008)	English (2003) English (2007)
	Prisons	Auditor-General (2010)	Andrew (2009)
	Railway	----------	Ng & Loosemore (2007)
	Schools	AUDIT (2006b)	----------
	Health	----------	Chung (2007)
	Individual projects evaluations	Auditor-General (2007)	Darvish (2006) Chan (2008)
UK	Overall projects	Andersen (2000) MacDonald (2002) Pollitt (2002) NAO (2003) Pollitt (2005) NAO (2009e) NAO (2009d)	Shaoul (2005) NAO (2010a)
	Schools	Commission (2003) CCPPP (2010) Demirag, Khadaroo, Stapleton, & Stevenson (2010)	Ball (2000) McCabe (2001) Ball (2007)
	Health	NAO (2010b)	Froud & Shaoul (2001) Pollock (2002) NAO (2006) Barlow & Köberle-Gaiser (2008) Cuthbert & Cuthbert (2010)
	Roads	----------	Shaoul et al. (2006)
	Defence	NAO (2009a)	----------
	Individual projects evaluations	----------	Shaoul (2002) Pollock et al. (2005) Pollock et al. (2007) Nisar (2007)

Table 10 (continued)

Panel B : Comparable studies on VfM by country and type of methodology					
COUNTRY	**PPP PROJECT**	**STUDY SHOW VfM**		**STUDY NOT SHOW VfM**	
		AUTHOR	**METHODOLOGY**	**AUTHOR**	**METHODOLOGY**
AUSTRALIA	Overall projects	Group (2007)	•Compares costs and times between traditional procurement and PPPs	English (2003)	•Based on PPPs' performance audits
		Forum (2008)	•Compares capital costs between traditional procurement and PPPs	English (2007)	
UK	Overall projects	Andersen (2000)	•Calculates the cost of the PSC (with risk adjustment) and compares it with the PPP cost	NAO (2010a)	•Compares the conclusions of five previous NAO reports
		MacDonald (2002)	•Compares real costs and time execution with the base case		
		Pollitt (2002)	•Case-studies and overall NAO assessment		
		NAO (2003)	•Compares the PPPs cost with traditional procurement cost •Assumes the latter to have a certain price, be completed on time, and have the same quality output		
		Pollitt (2005)	•Case studies		
		NAO (2009e)	•Based on conclusions of previous reports of NAO		
		NAO (2009d)	•Survey: Do PPPs achieve contracted price, time, and quality?		
	Schools	Commission (2003)	•Compares PSC with PPPs	Ball (2000)	•Survey on risk impact
		CCPPP (2010)	•A survey on opinion of several stakeholders	McCabe (2001)	•Case-study
		Demirag et al. (2010)	•Survey	Ball (2007)	•Analysis of VfM without risk transfer
	Health	NAO (2010b)	•Compares real costs /specifications with contract; •Compares management with best practices;	Shaoul (2005)	•Compare PSC with PPPs
				Barlow & Köberle-Gaiser (2008)	•Interviews and case studies
				Cuthbert & Cuthbert (2010)	•Case-study

Chapter 2

Anatomy of Public–Private Partnerships: Their creation, financing and renegotiations

ABSTRACT

This paper presents the main reasons why public-private partnerships (PPPs) are adopted as well as the possible disadvantages for the public and private sectors. By means of two case studies on bridge construction and railway infrastructure (Fertagus and Lusoponte), we elucidate how a PPP is structured and financed. Furthermore, the two case studies illustrate how the renegotiation processes are conducted when the public-private contracts have to be altered and what determines (un)successful renegotiations.

KEYWORDS**:** Public–Private Partnerships; Concessions; Renegotiations; Case studies; Transports

JEL CODES: G32, H54, L91

1. Introduction

In public-private partnerships (PPPs), the private sector plays a role in developing and maintaining public infrastructure and services, which is usually a public sector responsibility. PPPs are a recent phenomenon and were first experimented with approximately 20 years ago. As the design, construction, operation, financing, ownership and risk transfer of PPPs are country-specific, it is difficult to establish a clear definition of PPPs (Duffield, 2010)[1]. In some European countries, such as the UK, Portugal, Greece, Hungary, Cyprus, Spain, Ireland (EIB, 2009)), but also in the US, Canada, Australia, New Zealand and South Africa, private sector participation in infrastructure and public services through the use of PPPs has become increasingly popular (Hodge & Greve, 2009).

This paper offers a systematic and integrated approach to the main concepts, definitions, models, characteristics, structure and financing of PPPs. We analyse why basic infrastructure and public services must be guaranteed by governments and how the private sector has been instrumental in establishing such infrastructure and services. Furthermore, we also concentrate on how PPP renegotiations are conducted. To detail typical PPP structures and financing

[1] For various definitions, see, e.g., (Bovaird, 2004; CCPPP, 2001; Corner, 2006; Hardcastle C., & Boothroyd K., 2003; Hodge & Greve, 2007; Kirk & Wall, 2001; Klijn & Teisman, 2000; Linder, 1999; OECD, 2008; Savas, 2000; Treasury, 1998).

models, we use two case studies on completely different projects: Fertagus and Lusoponte. We answer the following questions: (1) How are PPPs established? (2) How does the private sector structure and finance a PPP relative to a private set-up following a traditional procurement? (3) Why and how are PPPs renegotiated?

This paper contributes to the literature by addressing both the advantages and disadvantages of PPPs. For example, the main advantage of a PPP—the fact that PPPs are 'off-balance sheet'—comes with several disadvantages: the budget 'temptation' and future liabilities. We show that the structure, financing, and life cycle of a PPP are significantly different from those of a traditional, privately owned project. For example, there are differences in portfolio management, asset ownership, project duration, amount of debt and risk, dividend policy, and shareholder structure. Although most renegotiation studies focus on the determinants that lead, in macro terms, to successful renegotiations, there is a lack of research on the negotiation process, which can be induced by financial distress, increased bankruptcy risks, and a changing political agenda.

This paper is organised as follows. Section 2 reviews the fundamental concepts of PPP. Section 3 lays out the structure and financing of PPPs. Section 4 reviews renegotiation theory. Section 5 presents the two case studies and the data used, and Section 6 discusses the renegotiation dynamics of Lusoponte and Fertagus. Conclusions are provided in Section 7.

2. Main concepts of PPPs

Traditionally, the public sector is responsible for providing specific services such as defence, security, justice, education, health, and culture, and for building basic infrastructure such as roads or prisons (Savas, 2000). The reasons why these types of services or infrastructure are not provided by the private sector are described in economic literature as 'market failures' (Stiglitz, 1989; Chong, Huet, Saussier, & Steiner, 2006b). The private sector is not eager to deliver these types of goods and services because they are not profitable. However, for social or political reasons, they must be made available to society. Therefore, it becomes the public sector's responsibility to ensure universal access to these goods and services. Another reason for the public sector's provision of the above-mentioned services and infrastructure is that they may be 'natural' monopolies, requiring some source of public intervention (Grimsey & Lewis, 2002b). In additional, some of these services or types of infrastructure generate positive externalities (the classic example is the construction of a new road that reduces travel time and accidents). Another example is the provision of health services that will lead to a healthier population, with a positive impact on reducing absenteeism and augmenting

productivity and economic growth (Sachs, & Tiong, 2005). Infrastructure comprises various types of fixed investments that are characterised by a long duration in construction and operation, as well as indivisibility, capital intensity, and a complex valuation process (Grimsey & Lewis, 2002a). This type of infrastructure usually requires a high initial investment, and it is only financially viable over the long run, which may extend beyond the scope of the private sector (Delmon, 2009). Although the public sector is responsible for guaranteeing specific services and infrastructure, its role has changed in recent decades; the public sector remains the guarantor but is in some cases no longer the provider. In fact, the private sector plays an increasingly important role in providing in some countries' services and infrastructure that have traditionally been the public sector's responsibility (Grimsey & Lewis, 2004).

2.1. PPP definitions and different models

To mark the boundaries of a PPP's role and scope, let us first discuss the various stages of the project: (1) conception, (2) design, (3) construction, (4) financing, (5) operations and maintenance (O&M), and (6) residual value or transfer of the infrastructure from the private sector to government at the end of the contract. In traditional procurement, the government is responsible for all of these stages. When construction is contracted to a private firm, the final responsibility lies with the public sector, which stands in contrast to privatizations where the asset or service is completely transferred to the private partner along with all risks and rewards (Savas, 2000; Demirag & Khadaroo, 2008).

The difference between PPPs and traditional procurement or privatisation is that the responsibilities over the several stages of a PPP project are divided between the public and private sectors. De facto, in a PPP, the public sector purchases a service under specific terms and conditions (Grimsey & Lewis, 2002b).

Figure 1 shows the different government procurement models. In traditional procurement, the government is responsible for all stages of the process, i.e., for project, risk, costs, budget treatment, financing, contract and ownership, whereas in a privatisation, the private sector takes on all of these responsibilities. In PPPs, some stages of the project are public responsibilities, whereas others are private. Consequently, risks are allocated between public and private sectors. For example, construction, financing and O&M usually falls under the private sector, whereas political risks, administrative licenses and other risks, e.g., unilateral changes, remain with the public sector. Table 1 summarises the public and private responsibilities for each model.

[Insert Figure 1 and Table 1 here]

2.2. Aspects of PPP contracts falling under the responsibility of the public sector

The specific issues faced by PPP regarding the public sector are summarised in Table 2, and the rest of this section provides a close look at some of these issues.

In PPPs, the private sector assumes all costs during the investment stage, enabling the government to avoid the investment's impacts on the budget and national debt. Only future payments will affect public expenditures. In contrast, capital and operational expenditures are public expenses in traditional procurement, which may create a direct budget deficit and immediately pile up more public debt. Figure 2 describes the financial outflows for the government under these two scenarios.

When building infrastructure by means of traditional procurement, there is a high level of cash outflow during the investment stage and usually low levels of O&M. However, major repairs could occasionally be necessary, leading to an increase in operating costs. In PPPs, there are no cash outflows during the investment stage, and payments are made to the private consortium during the operational stage only. Those payments cover the investment, O&M, debt service, and corporate taxes and provide shareholders a return. The shapes that these payments can take are shown in Figure 2.

[Insert Table 2 and Figure 2 here]

The public budget finances traditional procurement, i.e., by taxes and debt, whereas in a PPP, investment is made by means of equity and debt as financing is commonly a private sector responsibility. The main differences between project financing and traditional corporate financing are discussed below (in section 3.3).

In traditional procurement, the government and the construction firm set up a construction contract for building an infrastructure. In a privatisation, a selling contract is negotiated from the public to private sector. However, in PPPs, a concession contract is agreed upon between the public and private sector. This contractual framework combines construction, financing, and operation (Hart, 2003) and is limited in time (usually long term—30 or more years). Although the contract does not cover or predict all conditions or future events, the concession contract is complex and covers a wide range of issues such as conditions of the design, construction, financing, O&M, public and users' payments, and the residual value or the final transfer of the asset to the public sector. In addition, the PPP comprises a series of detailed contracts with third parties: a construction contract with the construction company, a financing

contract with syndicated banks, outsourcing contracts for O&M, insurance contracts to cover risks and a shareholder's agreement that defines the long-term relations with the PPP owners. Although the public sector is not formally present in these contracts, it is critical to the PPPs' success, and governments should therefore still carefully monitor.

The ownership of the asset also differs among procurement, privatisation, and PPP. As a privatisation is de facto a selling contract, the ownership of the asset is completely transferred to the private sector. In traditional procurement, in contrast, the assets remain in the hands of the public sector. In PPPs, the physical asset also remains public, even over the duration of the concession contract, and the PPP private company usually recognises the concession contract in the balance sheet as an intangible asset during the concession period. Afterwards, the assets revert to the public sector, usually with a residual value of zero.

2.3. PPP advantages and disadvantages

What advantages does the government see in PPPs relative to traditional procurement? Why are academic studies sceptical about PPPs as an alternative use of public funds? The advantage ascribed to PPPs that is most frequently advanced is the 'off-balance sheet' accounting of this transaction (Grimsey & Lewis, 2005). PPPs have no impact on public expenditure and therefore no impact on the public debt during the investment stage; only the future payments from government to the PPP will be accounted for in the public budget. This advantage embeds a potential danger, namely the temptation to avoid budget constraints, which may lead to a debt overhang. We use this term to refer to the condition of an organisation (either government or a company) under which the debt level is so high that the organisation is no longer able to attract more debt, even if the debt conditions are favourable to new investments (Cordella, Ruiz-Arranz, & Ricci, 2005). Some countries have established many projects over a short period of time, raising concerns about their affordability (Grimsey & Lewis, 2002a ; Froud, 2003). Future payments can threaten the sustainability of public finances in some cases, as liabilities may only arise when payments are due (Maskin & Tirole, 2008). As such, the impact of PPPs on governments' future budgets is also an issue of concern (Guasch, Laffont, & Straub, 2007b).

The second advantage of PPPs is the possibility of building an infrastructure that otherwise would not be built because of budget restrictions (Debande, 2002; Grout, 2005). In several countries, PPPs have been instrumental in reducing infrastructure gaps. However, as budget constraints are less binding, concerns about rational decision making have emerged. The PPP approach may induce governments to be less careful in their choice of projects. (Heald &

Georgiou, 2011) show that in some cases, assets are chosen with little (or even no) economic or social rationality, which is attributed to the fact that governments tend to not separate the investment decision from the financial decision.

Third, PPPs aim at generating Value for Money (VfM), the idea being that the same quantity and quality of services can be provided at a lower overall cost. The goal of PPPs is to achieve microeconomic efficiency of public money in terms of a better use of those resources because of better management (OECD, 2008). However, VfM is complex to measure and has led to an intensive debate on whether PPPs really do generate VfM (Broadbent, Gill, & Laughlin, 2008). A pitfall in VfM valuation is that the concept is mainly based on risk transfer (Ball, Heafey, & King, 2007). Academics provide the following reasons for why PPPs do not deliver sufficient VfM: (i) the private sector assumes few risks and thus has few incentives to pursue better management and efficiency; (ii) risk is an ambiguous and complex concept, leading to valuation uncertainty; (iii) the methods used to valuate risks are considered incomplete, as the public sector usually adopts simple valuation tools, often based on a qualitative approach; (iv) the public sector comparator favours PPPs because of an 'optimism bias' or the use of excessively low discount rates; and (v) PPPs often only show VfM after a risk transfer.

Fourth, the private sector assumes some of the risks of a PPP project, which is considered yet another advantage compared to traditional procurement. Nevertheless, Ng & Loosemore (2007), and Broadbent et al. (2008), note that the valuation of risk transfers is not straightforward and hinges on some subjectivity (Shaoul, 2005; Ball, Heafey, & King, 2007). Pollitt (2002), and Klijn & Teisman (2003), argue that this situation is aggravated by the public sector's lack of experience.

Fifth, the public sector can focus more on strategy and less on operational tasks when it initiates a PPP (Bovaird, 2004). Still, PPP contracts are long-term (usually more than 20 years), and government policies are not necessarily consistent over time following changes in government, making strategic planning even more difficult and unpredictable (Heald, 2003).

Sixth, a PPP represents simplicity as it leads to just one contract between the public and one private company, whereas traditional procurement brings about a multitude of contracts. Nevertheless, despite the PPP contract's complexity, it is unavoidably still incomplete (Blanc-Brude, Goldsmith, & Valila, 2006), which can and frequently does lead to future renegotiations (Guasch, Laffont, & Straub, 2003). Furthermore, a single contract also induces asymmetric information because it allows the private sector to have more information than the public sector; in addition, there is no competitive environment once the contract is signed. This situation could lead to 'opportunistic behaviour' on the part of the private sector (Parker & Hartley, 2003; Guasch, 2004; Chong, Huet, & Saussier, 2006a), which occurs when a

contracting party strategically uses the contract's imperfections to obtain a higher proportion of the value generated by the contract at the expense of its contracting partner (Chong, Huet, & Saussier, 2006). For instance, Ho & Liu (2004) claim that in cases in which the private sector can easily obtain a renegotiation, the private sector would be able to opportunistically behave with respect to contract obligations. These conditions may result in the public sector choosing an inferior option (adverse selection) or moral hazard from the private sector (accept a lower price at the bidding stage, with the goal to later, without competition, renegotiate, leading to extra costs to users and/or taxpayers). The advantages and disadvantages are summarised in Table 3.

[Insert Table 3 here]

3. PPP structure and finance

3.1. The procurement process leading towards a PPP

The Portuguese case provides us an example of this procurement process.

Before making a decision to develop a public investment through traditional procurement or PPP, the Portuguese government is obliged to create a task force to study and analyse the project. The task-force report is a necessary starting point for launching a PPP because it comprises the main characteristics of the technical, legal and financial issues for each project.

The procurement process for PPPs in Portugal follows several stages. The first step is for the sectorial minister who is planning the project to notify the Ministry of Finance. This notification set up a committee responsible for preparing a preliminary evaluation of the project and the decision to use a PPP instead of public procurement. This also includes a feasibility study, a strategic plan and the legal instruments to perform the procedure prior to the bidding. It is also expected that this committee will evaluate the initial studies that support the project.

After the decision to use a PPP, the process begins with the opening of a tender procedure that contains the following information and conditions: PPP contracting procedures and specifications, analysis of the options that determine the configuration of the project, project descriptions and financing, demonstration of the public interest to justify the choice of using a PPP, demonstration of the affordability of the costs and risks, and an environmental impact

statement (Verhoest et al., 2013). Given that the PPP involves vast amounts of investment, it is mandatory to make an international announcement and publish the tender in the Official Journal of the European Community. The government, after receiving the bidders' proposals, makes a first evaluation. The evaluation criteria are of a technical and financial nature. In most of the projects, the criteria are as follows: (i) minimising the public financial input (approximately 30% of the final award classification), (ii) the technical quality of the proposal (in terms of the conception, project, construction and exploration, worth approximately 50% of the classification) and (iii) the service quality and security.

The best-qualified bidders are shortlisted, and a round of negotiations starts. At the end of the negotiation process, two bidders are allowed to present their best and final offer. After a final evaluation of these proposals, the Finance Minister and the Sector Minister make a joint decision on the winning proposal. The ultimate stage is the signing of the PPP contract between the government and the private party. As there is no contract template, each PPP agreement is a tailor-made contract based on the tender specifications. However, some elements are mandatory, such as the programme´s contracting procedure, the project analysis, the project description, risk allocation, budgetary costs and financing and the environmental impact.

Ultimately, several entities are involved in the PPP process, with different roles and responsibilities: the sectorial minister is responsible for the project initiation, invitation to the bidding and budget allocation for the future payments. The Ministry of Finance is responsible for the project approval, negotiation, bid approval and contract monitoring and management. The first committee has a role in assessing the feasibility and Value for Money. The second committee is responsible for the bidding process.

We have found a variety of payment mechanisms in the 35 Portuguese PPPs. In the road sector, there are some PPPs with payments based on levying tolls whereby the private party bears all the traffic risks. By contrast, in all the other road projects, the payments to the private sector are based on availability, and the toll revenue goes to the public sector. The revenues of the two railway PPPs depend on the tolls. As for the health sector, as we have seen, for each hospital there are two PPPs: one responsible for building and maintain the infrastructure, being paid by availability. The other PPP is responsible for the medical services. In this second PPP, payments are made according to the clinical production, but with an annual cap on public payments. Prices for each clinical service or action are based on a price system equal to the one used for National Health Service hospitals.

3.2. PPP structure

For each PPP project, a Special Purpose Vehicle (SPV) is created. The SPV represents a legal individual company that, however, only operates and owns one specific project/concession during the contract period. It is this company that will sign the PPP contract with the government. This company will be responsible for all stages of the project when they fall under the private sector (for instance, this comprises the phases of the design, construction, financing, operation, and maintenance). The reason why an SPV is created is that a project finance scheme is used (see the next subsection) (Yescombe, 2013). Thus, several relevant issues are addressed: (i) the lenders can evaluate the (fluctuations of the) cash flows that cannot be diverted to other businesses. This evaluation increases the lenders' confidence that the project will be able to repay debts. (ii) There is no recourse to the shareholders, protecting them with limited liability and non-resource (sometimes limited) financing. (iii) The project will not be affected by problems caused by other business operations, which could occur if an existing company were used to develop the project rather than an SPV.

SPV funding is derived from shareholders, banks, and bond markets. Financial advisers, lawyers and other types of consultants are involved in the SPV, especially in the planning stage and at the public bidding (Nevitt & Fabozzi, 2000). During the construction stage, the construction sub-contractors are responsible for building the infrastructure. In this manner, the SPV passes the construction risks on to third parties. At the operational stage, important relationships with outsourcing and insurance companies are established. Again, the SPV's goal is to pass the operational and maintenance risks to third parties.

Using Lusoponte as an example, we present a typical SPV structure (Figure 3). Lusoponte's SPV has attracted debt from banks and equity from sponsors. The construction of the new bridge was contracted to another company, Novaponte, which is owned by the same shareholders of Lusoponte. Operating and maintenance (O&M) was also contracted to another company, Gestiponte, owned by the same shareholders. Thus, construction and O&M risks were transferred to third parties. These risks will no longer affect Lusoponte's future cash flows, reducing the lenders' uncertainty about the SPV's ability to repay the debt.

[Insert Figure 3 here]

The PPP framework is described in Figure 4. Although the public sector is often described as a single entity, there are in fact several independent parties, such as the government that issues the contract, the national audit office (NAO) that controls the use of public money, and a PPP-dedicated unit (e.g., at the ministerial level) that monitors the concession.

The public stakeholder is the government that signs the concession contract with the private sector. As PPPs are usually created in regulated and low-competition markets (such as transport, health or education), the regulatory agencies of that specific sector usually play an important role, which is especially true during the operational stage, when the task of the public sector is to monitor the private sector. This monitoring requirement does not only arise from the contract, as regulated markets necessitate supervision, regardless of the contractual responsibilities of the public and private sectors.

Because PPPs involve public money, other important entities in the public sector will be involved at a later stage, including organisations such as the NAO[2], or as it is called in some countries, the Court of Audits. An NAO is an independent body that scrutinises government actions and decisions. Although it is part of the public sector, the NAO is independent of the executive power. They also tend to sanction poor decisions or at least provide recommendations for the better use of public money.

Another important public entity present in most countries is a PPP-dedicated unit. This unit is defined as 'any organisation set up with full or partial aid of the government to ensure that the necessary capacity to create, support, and evaluate multiple PPP agreements exists' (OECD, 2010, pg.11). Therefore, a PPP unit is a government department that oversees the complete life cycle of the PPP (Farrugia, 2008). Both of these studies emphasise the importance of PPP-dedicated units for the ultimate success of PPPs.

[Insert Figure 4 here]

3.3. PPP finance

PPPs are financed by the private sector using a scheme called project finance. This refers to 'a non-resource or limited resource financing structure in which debt, equity, and credit are enhanced for the construction and operation of a particular facility in a capital-intensive industry' (Fight, 2005). Typically, PPPs (especially with respect to infrastructures such as highways) require high capital investment and low O&M costs. Revenues mainly serve to cover depreciation and debt service and, to a lesser degree, to yield shareholder return. The high capital investment phase (during the construction phase, normally the first 4–5 years of the contract) is mainly financed through debt. (Esty, 2004) reports project finance to have debt levels of 70%–90%, with equity covering the remaining part. For the United Kingdom, the debt levels amount to 80%–90% (Spackman, 2002), whereas for the Portuguese highway

[2] National Audit Office

sector, the reported debt amounts to a similar percentage of investment (Sarmento, 2010). Debt is often called 'non-resource debt', which indicates that lenders rely solely on future cash flows for debt service (repayment of principal plus interest).

PPP debt consists of senior and mezzanine (also called junior or subordinated) debt. During a construction stage of 4 or 5 years, milestone payments are to be made to the construction company (Yescombe, 2013), indicating that the same level of financing is not necessary at any moment in time; project finance follows a drawdown in financing (Figure 5). The SPV first uses the mezzanine debt as a resource, followed by equity, and finally senior debt. In the operational stage, the reimbursement of debt and equity follows a different path (Figure 6). The SPV first pays back the senior debt (which has a priority right on the cash flows), then mezzanine debt and only subsequently the shareholders' equity. Usually, the debt maturity is shorter than the project duration (Gatti, 2012).

[Insert Figure 5 and Figure 6 here]

In Table 4, we compare project finance to the typical financing of corporations (corporate finance). The main difference lies in the nature of the company. In project finance, the company is an SPV, which means that the company only operates one particular project such that one could state that the company is in fact the project.

In project finance, debt represents at least 70% of the investment, often more. This figure is three times greater than in traditional corporate finance (Esty, 2004). In a company, the shareholders ultimately own the assets, and debt is usually guaranteed by those assets, or at least in part. In project finance, debt is only guaranteed by the future project's cash, and the SPV does not own the asset, but only a concession contract for a long but limited period.

Business risk and, consequently, interest and discount rates can significantly vary across firms. Nevertheless, before the recent financial crises, this variation was very low in project finance as the interest rates used for discounting were not significantly above the risk-free rate, which reflected the low level of project risk.

A disadvantage of project finance is that transaction costs are higher than those in traditional corporate financing because the concession contracts are complex and incomplete. However, the long-term high level of investment in project finance enables more efficient financing. By transferring risks to other parties (who can manage them better), project finance promotes more efficient and transparent risk sharing and risk management. Ultimately, high leverage with a low risk premium allows for a reduced weighted average cost of capital.

[Insert Table 4 here]

4. Renegotiations

Many PPP contracts are renegotiated at one point in time. Renegotiations (also known as financial rebalancing or financial rescue agreements (FRAs)) are usually triggered by a specific event and affect the financial conditions of the concession (Yescombe, 2011). Renegotiations usually result from unpredicted or uncontrolled events, although some conditions triggering renegotiation are listed in the contract. It should be noted that adjusting tariffs for inflation is not considered a renegotiation. Only when substantial departures from the original contract occur and the contract is amended shall we label such a change as a renegotiation.

There are several reasons why renegotiations frequently occur in PPPs; the long-term and complex nature of such contracts and the political context make it impossible to foresee all future states of the world (Engel, Fischer, & Galetovic, 2009). There are three main events that trigger renegotiations: (i) bankruptcy of the SPV, obliging the public sector to rescue the project; (ii) failure due to incorrect contractual assumptions that affect the private partner's profitability; or (iii) a unilateral change by government that results in changes that affect the concession. Usually, a tariff increase or financial compensation from the government to restore the profitability of the PPP is the outcome of the renegotiations.

Renegotiations initiated by governments are usually related to political decisions that affect the concession contract or the financial conditions. These political decisions can affect several stages of the concession. At the design and build phase, governments can make changes in the project (reducing or increasing investments and additional works), change environmental requirements or create new administrative delays. Other changes can occur at the operational stage, such as specific legal changes or contract changes, regarding issues such as tariffs, service requirements, or payments.

Most PPP renegotiation studies relate to the South American transport, water, and sanitation sectors.[3] These studies document that the existence of a regulator, better quality of the institutional framework, GDP growth, and a low level of corruption reduce the probability of a renegotiation. In contrast, price caps on tariffs, a need for follow-up investments and new elections increase the odds that the concession contract will be altered.[4]

In sum, PPP renegotiations can be an opportunity to adjust and address new conditions and terms of a project and thus increase the projects value, on either the public or the private side.

[3] (Guasch et al., 2003; Guasch, 2004; Guasch & Straub, 2006, 2009; Guasch, Laffont, & Straub, 2007a; Guasch, Laffont, & Straub, 2008).

[4] (De Brux, 2010; De Brux, Beuve, & Saussier, 2011).

To illustrate how renegotiations work in practice, we will analyse two case studies, but we turn first to the methodology employed. Given that academic finance research on PPPs is still in its early days, the two case studies will demonstrate the specific characteristics and idiosyncrasies of PPPs in relation to the complex process of contract renegotiation.

In the next subsection, we will answer the following questions: Why and how did Fertagus and Lusoponte renegotiate, and what were the negotiations' outcomes?

4.1 Two PPPs: Fertagus and Lusoponte

Let us commence by introducing the two firms.

Fertagus

In 1997, the government decided to open a railway concession for the bridge named 'Ponte 25 de Abril' (the 25th of April Bridge) to improve the connection between the northern and southern parts of Lisbon. The concession contract with the private sector included investment in the transport material (rolling stock) and the railway service (operations and maintenance). The railway infrastructure was already available (when the bridge was built in the 1960s, it was prepared to have trains in the lower deck). The decision was to leave the infrastructure a public sector responsibility and allocate only the operations to a private company. In 1999, a contract was signed with Fertagus (one of the three bidders), a company owned by the Barraqueiro group, a private sector transport group already operating in the Lisbon metropolitan area but mainly in bus services.

The contract conditions stipulated an investment of €114 M, which was to be made only with private sector funding through a bank loan of €89 M and equity of €25 M (or 22% of the total investment). The concession had a 30-year duration, with the financial viability dependent on revenues from traffic (i.e., tolls). The contract included the traffic conditions (density) under which the private sector was allowed to renegotiate.

Lusoponte

In the early 1990s, the Lisbon urban area, south of the Tagus, was served by a single bridge[5] to reach the city. This situation presented a major constraint on traffic, not only in the city but

[5] It was originally (in 1968) called the 'Ponte Salazar,' and after the 1974 revolution, renamed 'Ponte 25 de Abril'.

also between the northern and southern parts of the country. In 1992, the government decided to open a bidding process for a second bridge. This new bridge, called 'Vasco da Gama',[6] connected the eastern part of Lisbon to the southern rim in Alcochete. Two consortiums participated in the bidding, and the 'Lusoponte' consortium won. A design, build, finance, operate, and transfer model was set up in 1993 to build the new bridge (to open in 1998). There was a condition that the O&M of the older bridge (the 'Ponte 25 de Abril') would become the responsibility of Lusoponte starting on 1 January 1996. Lusoponte set up a typical PPP structure with a consortium of eight shareholders (which during the concession period was to be reduced to five[7]).

The initial concession was financed by private and European Union funds, along with the revenues from the Ponte 25 de Abril, but without public funds. The total investment, €987 M, consisted of construction costs (€645 M) and other costs, including maintenance costs, payments to expropriate land and environmental costs. A significant amount of private debt was derived from the European Investment Bank (EIB). In 1993, before the introduction of the euro, Portugal was only able to borrow for the medium term (usually for only 3 to 5 years). A 20-year loan was only possible by borrowing from the EIB. Hence, most of the debt was derived from EIB and not from commercial banks. Ultimately, funding came from EU funds (€319 M - 32%); '25 Abril' revenues (€50 M - 5%); EIB loans (€299 M - 30%); bank loans (€120 M - 12%) and equity (€199 M - 20%), a total investment of €987 M.

The concession period was to end as soon as 2.25 billion vehicles had crossed both sides of the river (which was expected to occur between 2019 and 2022) or on March of 2028, whichever came first. To allow the project to be financially sustainable without public direct investment, three conditions were agreed upon at the time of contract: 1) The toll prices on the existing bridge ('25 de Abril') would increase at the beginning of 1994 to reach the 'Vasco da Gama bridge' toll prices by 1998; 2) After 1994, the existing exemption on toll payments during August for the '25 de Abril' bridge should end; 3) Until the end of the contract, if the government should decide to construct new bridges on the river, concession would have to be granted to Lusoponte. Thus, the absence of future competition was an important incentive to attract private funds for this project.

[6] In honour of the famous discoverer, on the 500th anniversary of the discovery of the sea route to India (1498).

[7] Initial shareholder structure: Kvaerner Group (24.8%); Campenon Bernanrd SGE (22.0%); Bento Pedroso Construções (14.8%); Mota e Companhia (13.8%); Somague (13.8%); Teixeira Duarte (7.5%); H. Hagen (2.8%); Edifer (0.4%).
Actual structure: Macquarie Infrastructure (UK) Limited (31%); Vinci Construction Grands Projects (31%); Mota/Engil, S.A. (14%); Somague Itinere - Concessões de Infraestruturas, S.A. (17%); Teixeira Duarte - Engenharia e Construções, S.A. (8%)

The fact that the first two assumptions were determined to be unrealistic at a later stage triggered renegotiations.

For each of the above mentioned PPPs, an SPV was created with long concession periods (20 years for Fertagus and 30 years for Lusoponte). Fertagus had a high level of leverage (78%), whereas Lusoponte did not (42%, which is unusually low in project finance). The reason for the low debt level is that European Union grants (subsidies) represented 32% of the investment. The debts in both companies were 'non-resource' and included both senior and mezzanine debt.

4.2 The process dynamics of the Fertagus and Lusoponte renegotiations

Fertagus

The Fertagus contract comprised a band traffic system with three bands (an upper, a reference, and a lower band) to share traffic risk between the government and the private company. The concession contract defined conditions in terms of the real traffic that was expected to use the railway during the operation period (see Table 5). If traffic estimations were understated and real traffic exceeded the upper band, Fertagus would face a reduction in tariffs and would be responsible for improving service. If traffic projections were too optimistic, with real traffic falling below the lower band, Fertagus could demand a financial rescue. The following was the government's guarantee to the private sector: the ability to address the possibility of overoptimistic government traffic projections, which would trigger a renegotiation. Fertagus could then ask for an increase in the concession period, tariffs and/or financial compensation.

[Insert Table 5 and Figure 7 here]

Over the period 1999–2003, the actual traffic was substantially below the lower band by 40%–60% in every year (Figure 7). This allowed Fertagus to ask for a renegotiation that resulted in several changes to the concession, leading to a better and more balanced agreement between the parties. These conditions and changes were as follows: the financial compensation paid by the government to Fertagus was €24 M in 2004, €21 M in 2005, plus a total of €65 M split over the period 2005 to 2010)[8]. The net payment for this period was approximately € 80 M.

[8] The claw-back system allowed the public sector to receive 75% of revenues if the real traffic level rose to the estimated traffic level, which eventually did happen. The government received a total of €12 M from Fertagus, which was caused by a claw-back agreement. New traffic projections were made, and the band system was abandoned. Additionally, Fertagus paid (between 2005 and 2010) a total of € 18 M for infrastructure usage.

Although the private sector received a financial compensation, the concession period was reduced to 10 years (but the possibility of a 9-year extension was created). This extension would only apply if the concession became financially viable without public support, which indeed occurred in 2010. Fertagus is currently operating without any public financial support (until 2019 when the concession ends). The reasons for reducing the concession period were primarily to limit the private sector's gains but also to ensure, if the SPV were to incur further losses, that the public sector would recover the project sooner, not having to face a new renegotiation process. A second change to Fertagus' contract was that the traffic risk, which was originally shared, became Fertagus sole responsibility. Third, the financial conditions were also altered: despite the higher project risk (due to the assumption of traffic risk), the profitability was decreased (the internal rate of return [IRR] dropped from 10.9% to 7.8%). Fertagus passed on the senior debt to the public sector, along with ownership of the assets, but remained responsible for the debt service. Fourth, a claw-back mechanism was introduced, regulating the sharing of unexpected revenues between the government and the private sector. Fifth, the service conditions were also revised; users had to pay a higher tariff for services, and the number of trains was reduced.

In the end, the public sector spent almost €80 M (in current 2014 prices) between 2004 and 2010, but the concession could remain open and is now financially independent from public money. After 2010, as foreseen in the 2004 renegotiation, the concession period was extended to 2019, with no further public compensation. In fact, from 2010 onwards, the public sector continues to receive the revenues above the case-base forecast. Moreover, from 2017-2019, the public sector will be entitled to 50% of those years' net income[9].

Lusoponte

Initially, the Lusoponte concession was completely financed by the private sector, EU funds, and the Ponte 25 de Abril bridge revenues. This financial scheme depended on the three conditions previously mentioned. The contract established that if any of these three conditions was not met, Lusoponte could demand a renegotiation of the contract and financial compensation from the government. Additional clauses that could trigger renegotiations included 'exceptional events' in the currency market (unfavourable movement of the Escudo/Deutsche Mark exchange rate—prior to the introduction of the euro) and specific legislative changes with a direct impact on the concession. Risks to the public sector

[9] Fertagus forecasted to deliver to the government €1 M in 2017, €1.2 M in 2018, and €1.4 M in 2019.

representing possible financial compensation to the PPP were limited to unilateral changes to contract, force majeure, specific legal changes, and delays in EU grant payments or delays in land expropriations. The compensation could be made by using each of the following three mechanisms (or a combination thereof): (1) increase in the concession period, (2) increasing tolls or (3) direct financial compensation. If any of these events were to occur, the project could be renegotiated. Public financial compensation would have to assure minimum project financial stability. In the contract, financially stability was determined by a 'ratio of debt coverage'[10] of 1.13 in 1998, 1.19 in 1999, and 1.25 beyond. In addition, the project minimum IRR (pre-tax) was established to be 11.43%.

In 1994, the government increased the Ponte 25 de Abril tolls, which led to a major political crisis involving street riots and a bridge blockade. To avoid future conflicts, the government decided not to increase the toll, maintain the August exemption, and start a discount policy for frequent users. These changes were valid for one year and had to be renewed each year (over the period 1995–2000). As previously mentioned, the private sector investment was initially to be paid by tolls from both bridges. The fact that the '25 de abril' bridge toll prices did not increase reduced the expected revenues, unbalancing the financial base case. This loss of revenue led the company to request a renegotiation, which led to the first of five financial rebalance agreements (FRAs) (see Table 6).

[Insert Table 6 here]

In 2001, a global agreement (referred to as FRA 6) was reached to end the succession of FRAs. The agreement had three main objectives: (i) create a price policy that differentiates the toll prices on both bridges by keeping the price on the Ponte 25 de Abril bridge lower than that on the Vasco da Gama bridge, (ii) adapt the initial financial model to the new toll conditions, and (iii) end all of the remaining renegotiation requests and conflicts and adapt the concession to the new financial conditions of the Eurozone. These new conditions allowed for a refinancing of the concession and substantially lowered the cost of debt. Portugal´s entrance to the Eurozone, along with the borrowing conditions in the financial markets during that period, significantly reduced the country's interest rate, making credit abundant and cheap. The private sector fully benefited from these new financial conditions of Lusoponte.

The global agreement compensated the private partner in different ways: there was (i) a direct financial compensation (a total of €306 M, divided between 2001 to 2019); (ii) an increase in

[10] The level of debt that can be raised for a project is based primarily on the projected ability to pay interest and repay loan principal instalments, with a comfortable margin of safety. To assess this margin of safety, lenders calculate cover ratios, namely the DSCR (Yescombe, 2011). The DSCR represents the ability of a project to ensure debt service. The DSCR is equal to the interest payments plus debt amortisation as a percentage of free cash flow. To reduce credit risk, senior lenders require a minimum DSCR in each project.

the concession period, until 2030. Considering that in the initial contract the concession period was determined to last until 2.25 billion vehicles had crossed both sides of the river (which was expected to occur between 2019 and 2022), the concession period has increased 7 to 11 years beyond the initial projections. (iii) A change in the risk allocation matrix (reducing the risk to the private partner). (iv) The end of Lusoponte's responsibility for the Ponte 25 de Abril bridge's O&M (reducing the overall cost to the private sector). (v) The continuation of the concession at an 11.43% IRR pre-tax. (vi) If the corporate tax rate were to increase by more than 1 p.p., the government would have to compensate the company (see Table 7). In spite of these benefits given to Lusoponte, there was no claw-back clause that would allow the public sector to share future additional (unexpected) benefits.

[Insert Table 7 here]

The global agreement (FRA 6) has led to changes in the original risk allocation matrix. Three types of risks have changed: (i) Generic legislative changes (e.g., an increase in the tax rate would not affect this company, as the government would provide financial compensation for an additional tax burden). (ii) The operational risk of the Ponte 25 de Abril bridge, which was originally the private sector's responsibility, became a public responsibility, as the operational costs were paid by the Ministry of Transport. (iii) The financing and demand risks, which were allocated to the private sector in the original contract, are now shared between the two parties. Overall, the private sector risk level was decreased, but despite the reduction in the risk level of the project, there was no reduction in the PPP profitability (which is very different from that in the Fertagus case). In fact, now with less risk, Lusoponte has continued to have the same pre-tax IRR as in the initial agreement.

In 2007, Lusoponte asked for an FRA 7, following changes in corporate tax rates, a reclassification of vehicles in terms of toll payments, the introduction of tolls in the month of August and additional maintenance work necessary on the Ponte 25 de Abril bridge. As a consequence, the government directly paid Lusoponte €22 million.

These series of renegotiations over the past 15 years have significantly altered the concession characteristics. As we have described, there were changes in the risk allocation matrix, reducing the project risk. In addition, the debt conditions have improved, lowering the cost of debt to Lusoponte. However, the main change is that the project no longer solely relies on private funds. The several renegotiations resulted in a variety of types of public funding: direct financial compensation, an increase in the concession period and a reduction in the concession maintenance costs. How did this public funding change the overall funding of this investment? At the end of these renegotiations, the funding of the project had changed substantially. From an initial project without public funds (except EU subsidies), the project became mainly

financed through public resources. Focusing on the initial funding (the €987 M of investment mentioned previously), we learn that the public sector financial support resulting from the renegotiations amount to half of this value.

4.3 Main findings from the case studies

Up to this point, we have discussed how Fertagus and Lusoponte renegotiate. However, what can we learn from these two cases? Table 8 summarises the main findings.

First, the events that led to renegotiations were substantially different in each case: In Fertagus, it was the fact that demand was below the case-base estimation. In Lusoponte, it was a political decision to change the contract conditions, regarding toll prices. This led to a fundamental difference: In Fertagus, renegotiation was initiated by the private company that was facing imminent bankruptcy, giving stronger bargaining power to government. In Lusoponte, renegotiations resulted from the government's decision not to increase tariffs. This unilateral change in the contract gave the private company a strong asymmetric position in the negotiations.

[Insert Table 8 here]

This difference was aggravated by three other factors: (i) the fact that Fertagus belongs to a group whose sole business is to operate several public transportation firms in the Lisbon region may have an impact on the private-side negotiation position. There may have been a reputational cost to the private group in the collapse of the project or in the PPP being perceived by public opinion as inefficient and a waste of public money. (ii) In Lusoponte, changes in the public administration structure concerning the monitoring and evaluation of this project took place. At the beginning of the contract, Lusoponte was supervised by a specific government department (GATTEL). With the extinction of this department, the PPP competences regarding the project were divided between the Ministries of Finance and Transport. According to several Court of Audit reports, and as emphasised in (De Lemos, 2004), this division has created coordination problems, which have been aggravated by changes in government and policy. (iii) Another reason why Lusoponte did so well in the renegotiations was caused by the fact that the initial contract did not account for social and political risks. The two bridges have different users. Those who use the '25 de Abril' bridge do not frequently use the 'Vasco da Gama' bridge. Therefore, the former see the increase in toll prices as a tax to pay for a bridge that does not benefit them. In addition, the contract also

did not provide a preview of the necessary mechanisms to allow the public sector to validate the company´s financial demands.

Thus, although both projects had public financial support, their renegotiations outcomes were substantially different: Fertagus's renegotiation resulted in a more sustainable and robust concession that became financially independent as it relied only on commercial revenues (after 2010). This renegotiation resulted from two main changes in the concession: First, deleveraging of the Fertagus balance sheet led to better financial conditions. Second, the change in the demand risk made it possible for Fertagus to be more flexible in commercial issues (especially those related to traffic, such as prices, discount policies, and timetables) and focus more on operations. The public sector also benefited from the renegotiation: mechanisms for sharing upper-side revenue enabled the government to reimburse part of the public financial effort because demand has been above the new projections for traffic. In addition, the reduction in the project risk was followed by a reduction in company profitability. This renegotiation forged a new equilibrium between the private sector's profit and the public sector's interests.

In contrast, the Lusoponte renegotiation process was quite the opposite that of Fertagus. Several issues significantly changed because of the chain of renegotiations. In the initial concession, tolls were supposed to have the same price in both bridges. Between 1995 and 2000, toll prices for the '25 de Abril' bridge were frozen; after the global agreement, it was decided that a different price system for each bridge would be maintained. After the first renegotiation, a discount policy was introduced. In the global agreement, Lusoponte was granted a tax benefit to compensate for the increase in the corporate tax rate. Moreover, although the project risk was reduced, the concession profitability did not decrease. The government also increased direct compensation, extended the concession period, and reduced maintenance costs. In this renegotiation, the public sector gave in to anything requested by Lusoponte (see Table 6). This situation raises some doubts about whether the public sector was able to correctly assess the consequences of the demands from the private sector. These concerns were also expressed by the Portuguese Court of Audits. Furthermore, while real traffic during these years was above the traffic projections in the base case, whose benefits were entirely captured by the private parties, without being accounted for in the renegotiations. As a result, a substantial part of the investment (which was expected to be financed exclusively trough private funds and EU subsidies) was financed through public resources.

Ultimately, the Fertagus renegotiation shows that when both parties are committed to sustain current and future relationships, they are prone to negotiate a better agreement, ensuring long-term sustainability and value for both. From 1999 to 2004 (the renegotiation year), Fertagus

accounted for an accumulated loss of €32 M (a deviation of –600%) relative to the initial base case. From 2005 until 2010, the company had a total profit after taxes of €56 M (an increase of 42% compared to the renegotiated base case). Improved concession conditions, better management, and higher demand were the main causes of this turnaround.

In contrast, in Lusoponte, these renegotiations ended up requiring substantial public sector financial effort, which led to significant opposition to this project and contributed to a generally negative view of PPPs in Portugal. As indicated by (de Lemos, Eaton, Betts, & de Almeida, 2004), a complete risk management analysis requires an assessment based not only on technical factors but also on political and social factors.

5. Conclusion

We sought the answers to three research questions: (i) What are the main characteristics of PPPs? (ii) How does the private sector structure and finance PPPs? (iii) Why and how are PPP contracts renegotiated?

This paper advocates an integrated approach to PPPs, both from the perspective of the public and the private sector. Concerning the first question, the main reason why PPPs stand between traditional procurement and privatisation is the different role that the private sector plays in each stage of a project. However, PPPs also differ in terms of contract, ownership, risk, financing, costs, and public budget treatment. Regarding this last issue, by using a PPP, there are no costs to the public sector during the investment stage, but annual payments to the private company arise over the contract period. PPPs thus avoid budget constraints during the construction of infrastructure. Governments should carefully weigh the advantages and disadvantages of PPPs.

Regarding the second question, we document that PPPs are very different from traditional firms in terms of asset ownership, project duration, amount of debt and risk and shareholder structures. The financial engineering of PPPs (based on attracting high levels of debt solely based on the project cash flows) generates opportunities for more efficient use of capital.

The two case studies reflect, in response to the third research question, why and how both PPPs renegotiate. PPPs have specific characteristics, such as the incomplete nature of the contracts that make them prone to renegotiate. However, renegotiations are regarded as a pitfall in PPPs. In fact, the likely outcome of most renegotiations is an increase in the costs to users and/or taxpayers. Moreover, in many cases, there is a reduction in the quality of service, along with a lack of transparency in most processes. All of these factors make renegotiations

contribute to a generalised negative perception of PPPs and private sector involvement in public services. This view reduces the scope of the private sector to improve and reform the public sector, along with the private sector's ability to provide an alternative to public budget restrictions.

PPP projects must be designed to address the issues that can lead to renegotiations and to facilitate them in a balanced manner. In many cases, renegotiations are not used to improve the conditions of a project. However, renegotiations will be used to that end only if both parties are committed to creating a sustainable solution.

We observed all of these factors in both case studies. The Fertagus renegotiation was a success, allowing for a financially viable concession because both parties were committed to achieving a more robust concession. This success can be attributed to two reasons: the fact that Fertagus belonged to a group already operating in transport in the Lisbon area and the fact that renegotiation was requested by the private sector, facing eminent bankruptcy. By contrast, the Lusoponte renegotiation was a failure in which public funds were used due to political decisions instead of being used to improve public services. Regarding renegotiations, we can learn from these two case studies that governments should be extremely careful when designing a concession and a corresponding contract. Governments must anticipate on the possibility of renegotiation events. In addition, control and regulation of the contract during the long project life cycle are critical.

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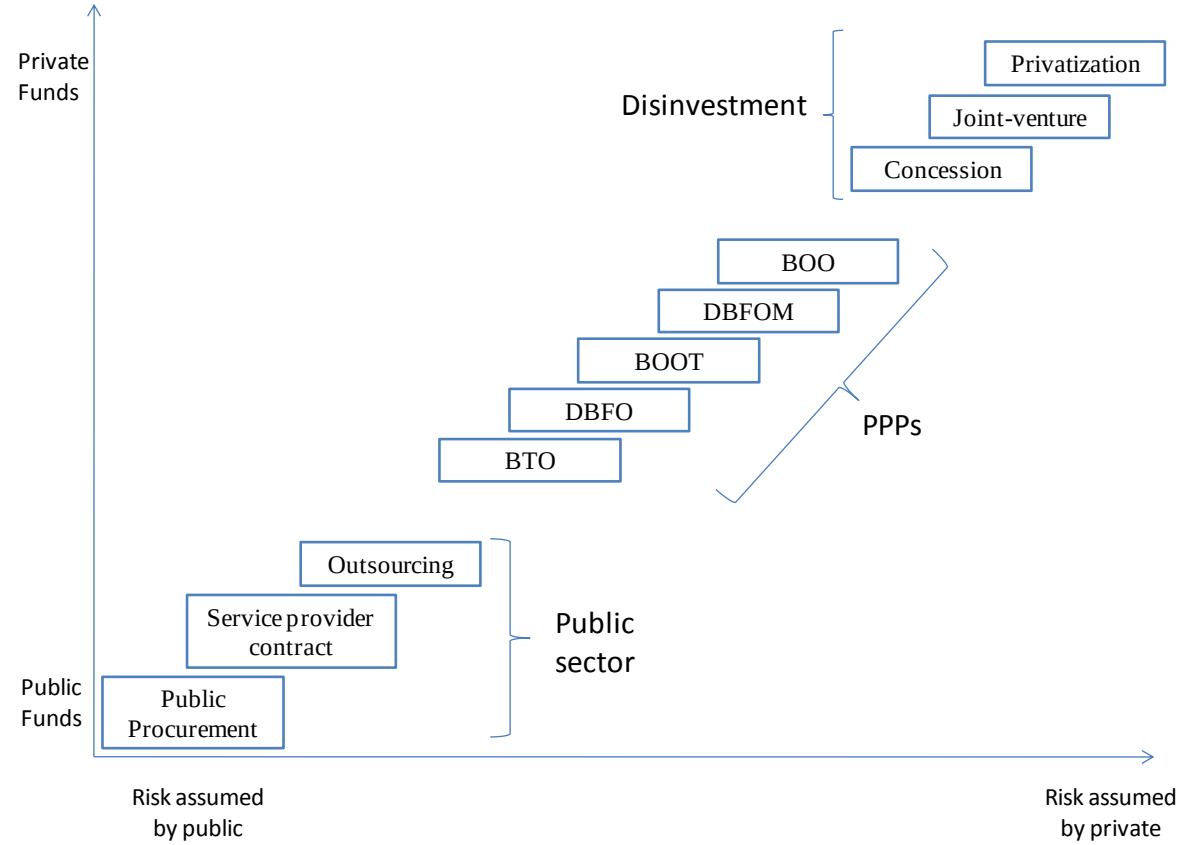
Figure 1- Different government procurement models



Source: own exhibit

Figure 2- Public procurement vs. PPP financial outflows in highway construction

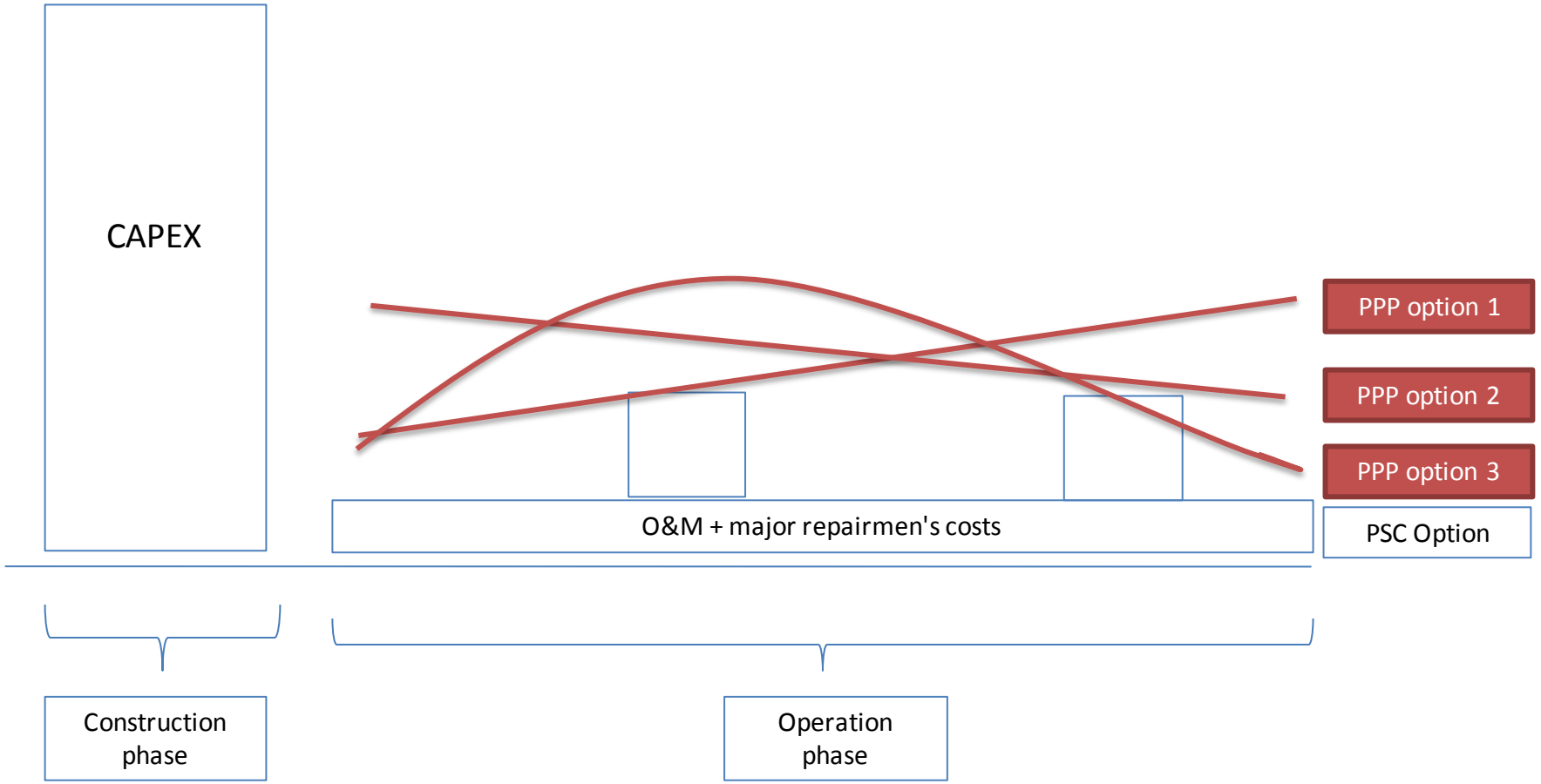


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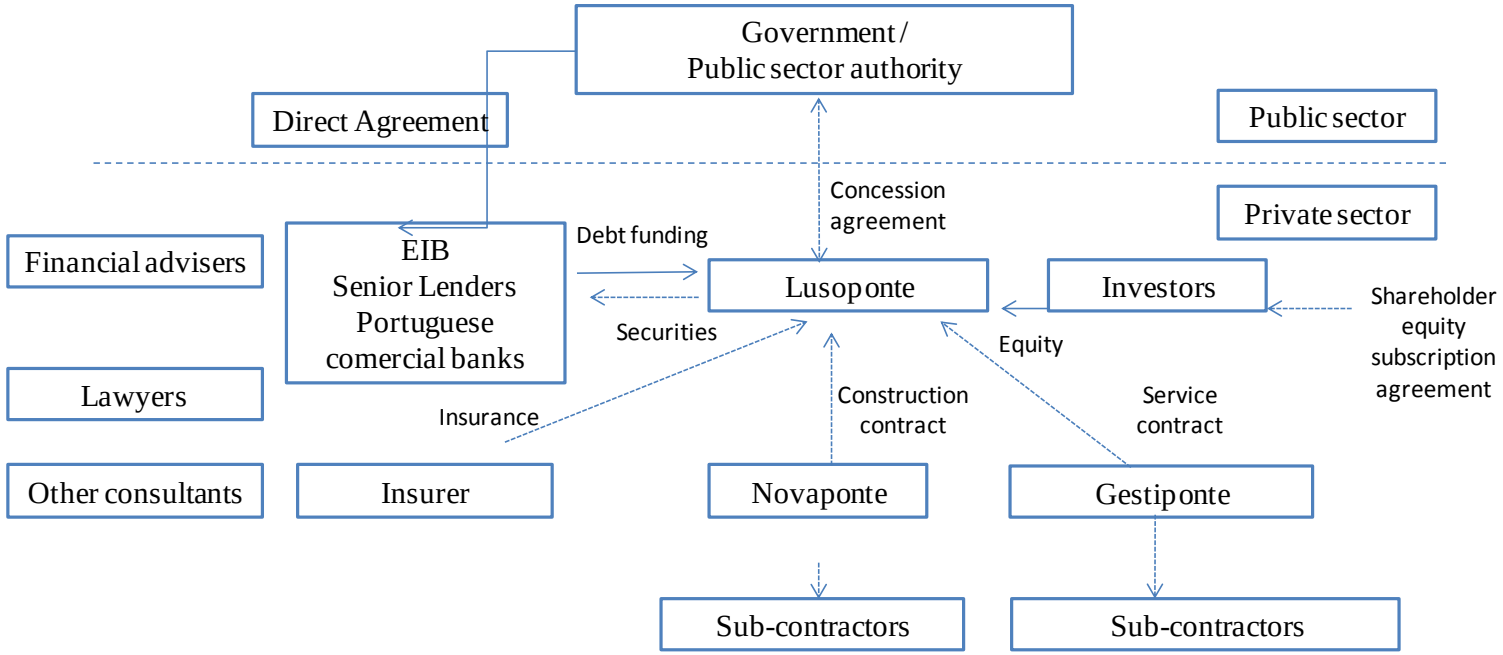
Figure 3– Lusoponte's PPP structure



Source: based on De Lemos et al. (2004)

Figure 4– A typical PPP structure

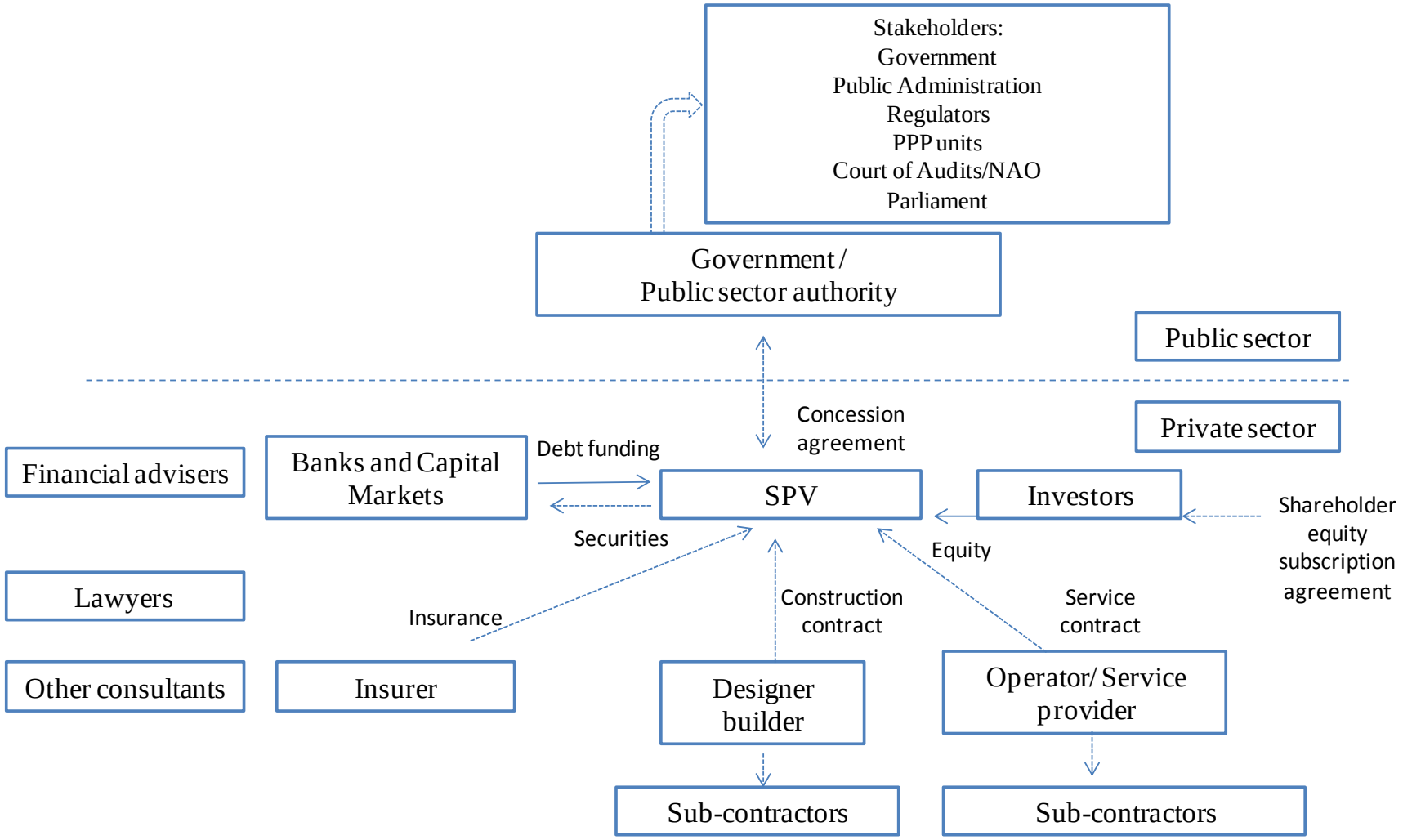


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Figure 5– PPP finance during the construction stage

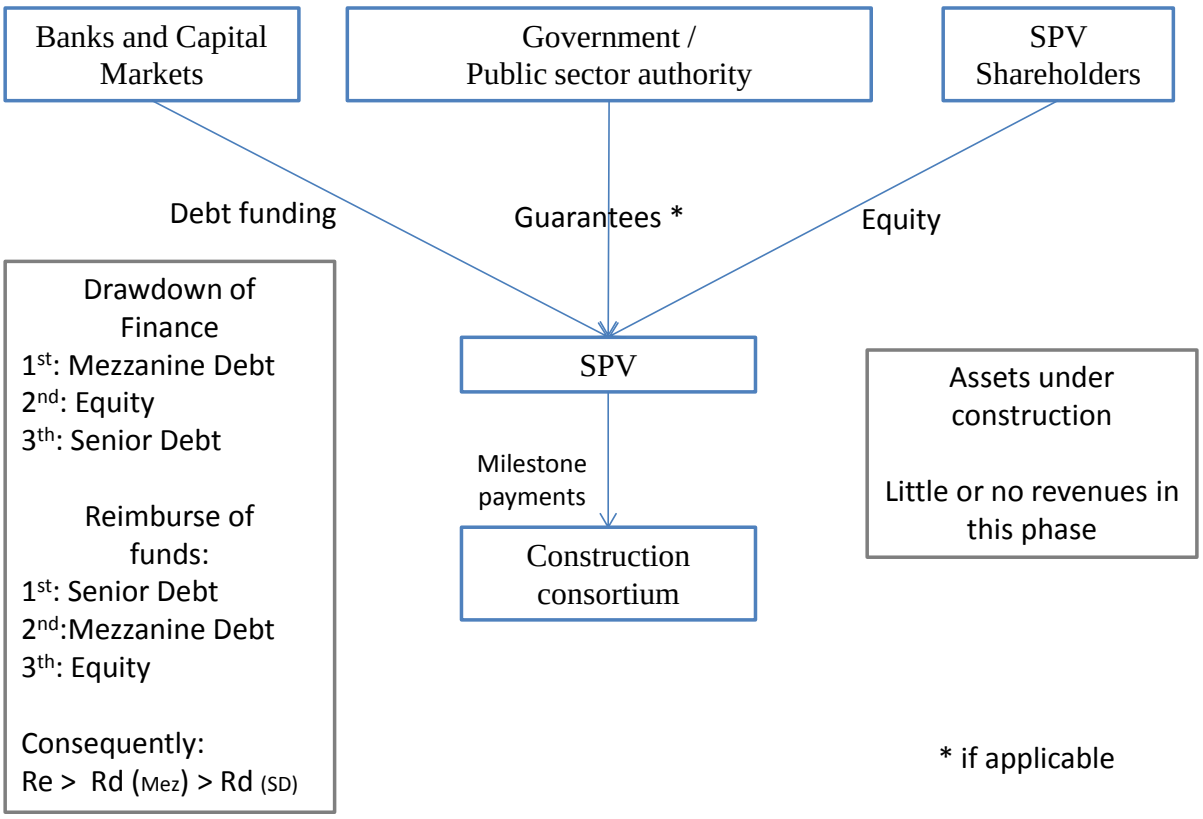

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Figure 6– PPP finance during the operational stage

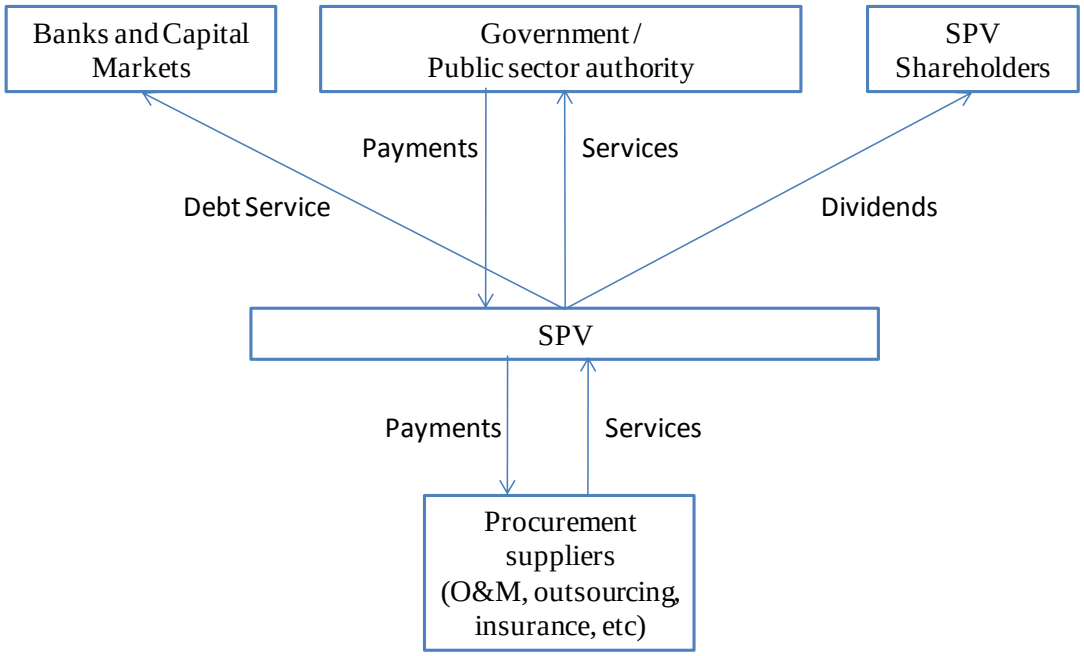

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Figure 7– Lower band traffic and real traffic in Fertagus from 1999 to 2003

Source: Fertagus and Court of Audits.

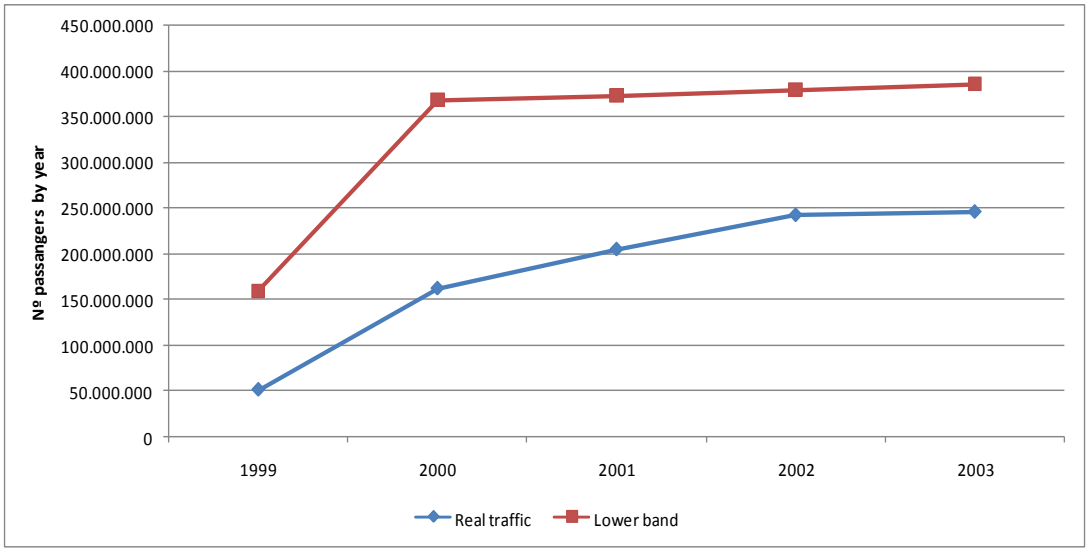

Table 1 – Different PPP models

This table presents the most common PPP models with the division of the responsibilities over the public/private sectors by project stage. Source: own table.

Model	Design	Build	Finance	Ownership	Operate	Transfer
BTO – Build, Transfer and Operate	Public	Private	Public	Public	Private	Private
DBFO – Design Build, Finance and Operate	Private	Private	Private	Public	Private	Public
BOOT – Build, Own, Operate and Transfer	Public	Private	Public	Private	Private	Private
DBFOM – Design, Build, Finance, Operate and Manage	Private	Private	Private	Public	Private	Public
BOO – Build, Own, Operate	Public	Private	Public	Private	Private	Public

Table 2 – The government's perspective on traditional procurement, PPP and privatisation.

Characteristics	Traditional procurement	PPPs	Privatisation
Project responsibility	Government is responsible for all stages of the project.	Government is responsible for planning the output and outcomes of the project and usually also for payments. The other issues are the private sector´s responsibilities.	Private sector is responsible for all stages of the project.
Risk	Risk is entirely (or almost entirely) assumed by public sector.	Risk is shared between public and private sector. Private sector assumes several risks, (usually: design, construction, financing, operations and, in some cases, demand).	Risk is completely assumed by private sector.
Costs	Private sector is only responsible for construction costs of the asset.	Private sector is responsible for the 'whole life costing' (capex and opex) of the project.	Private sector is responsible for all of the project costs.
Budget treatment	Capital and operational expenditures (capex; opex) are public expenditures, affecting government budget and national debt.	No impact on budget during the investment stage (PPPs are off-balance sheet). Only payments, during operational stage, are public expenditures.	No public funds. Private sector pays a price for buying the business.
Financing	Investment is financed through the public budget (i.e., taxes or public debt).	Investment is financed by private sector, equity and debt (usually through a syndicated bank).	Investment are completely private.
Contract	There is only a construction contract between government and a private firm.	There is a concession contract, for a number of years (usually 30 y or more), specifying the conditions of design, construction, financing, operation, payments and residual value/transfer.	There is a selling contract of the asset/service to the private firm, without time limitation.
Ownership	Asset is owned by public sector.	Asset is public or reverts to public at contract end.	Asset is completely private.

Source: own table.

Table 3 –PPPs advantages and disadvantages from a government perspective

This table discusses the advantages and disadvantages of PPPs from a public sector perspective.

Source: own table.

PPPs advantages	Reasons for advantages	PPPs disadvantages	Reasons disadvantages
Off-balance sheet debt	Increase fiscal space in the investment years	Affordability concerns debt 'overhang'; Future payments may threaten public finance sustainability; Liabilities may not be known until payments arrive; Government guarantees represent future liabilities	Reduces fiscal space for future years; Low budget transparency
Reduce infrastructure gap	Economic and social externalities from new infrastructure; Impact on GDP and on unit costs	Temptation to build assets with no economic or social rationality	Public funds wasted in bad projects; Cost of opportunity test
Achieve Value for Money (VfM)	Better use of public resources	VfM is complex and difficult to measure; VfM is based mainly on risk transfer	It is not clearly that PPPs are more efficient than the alternative models
Risks transfer to private sector	Risks allocated to party best able to manage them Private sector higher efficiency	Risk is complex process; Bias in PPPs' favour; Public sector lack of experience	
Public sector focus on strategy, rather than operational tasks	Enables public managers to address key issues and not disperse with non-significant problems	Lack of clear public policies and objectives; PPP planning is complex	Long term and complex contracts
A single contract with one entity	Increases transparency; Easier to manage and control	High percentage of renegotiations	Incomplete contracts lead to little flexibility and promote renegotiations; Asymmetric information reducing competition and efficiency

Table 4 – Corporate finance versus project finance

This table presents the main differences between corporate and project finance. Source: own table.

Issue	Corporate Finance	Project Finance
Company portfolio	Usually a large portfolio of business units and, in some cases, in several countries.	The Special Purpose Vehicle (SPV) only owns and operates the project.
Asset ownership	Shareholder ultimately owns the assets.	Usually assets belong to governments (especially in PPPs); the SPV owns a concession contract.
Duration	No limit in time.	The concession contract period is often long but limited (20-30 years).
Debt guarantees	Debt is guaranteed by the assets.	'Non-resource debt'. The only guarantee is the future cash-flows of the project.
Debt priority	Bank debt is usually secured. If not, there is no debt bank prioritisation.	There is Senior and Junior debt. Cash-Flows first repay Senior, later Junior and finally equity return.
Debt balance sheet	Debt appears in company's balance sheet.	Debt is on the SPV balance sheet.
Leverage	Medium level (30%-40%) (Esty, 2004).	High level: (70%-90%), (Esty, 2004); (Blanc-Brude & Strange, 2007) (80%-90%), (Spackman, 2002); (80%-98%), (Sarmento, 2010) In some cases, close to 100%, (Ye & Tiong, 2003).
Debt optimisation	Debt level is related to total assets and equity.	Adjust debt to the project cash-flows, optimising the level of leverage.
Interest rates on debt	Level of interest rates is firm-specific.	Interest rates are usually low (spreads from 1%-2%), a little above the free-risk rate.
Business risk	Significant variation, firm-specific	Low level of risk for sponsors and lenders
Dividend policy	Decided by board of directors.	Dividend policy is fixed. Dividends are almost 100% of net income. No reinvestment outside the project is allowed by the SPV.
Transaction costs	Low, due to strong competition.	High because of incomplete and complex contracts.
Shareholders structure	Varies, can be dispersed.	Limited number of shareholders.

Table 5 - The traffic bands in the Fertagus concession

This table shows the predicted traffic bands in Fertagus's initial contract and the conditions of the private company for each traffic scenario. Source: Fertagus

Annual traffic	**Conditions to Fertagus**
Above the upper band	Improvement in the service and a review of tariffs.
Upper band	Increasing costs to Fertagus
Reference band	According to the concession conditions
Lower band	Reducing costs to Fertagus
Below the lower band	Financial rescue

Table 6 – Synthesis of the first five Lusoponte Financial Rebalance Agreements

This table summarises the outcome of the first five renegotiations (1995 - 2000). Source: own table, based on Court of Audits information.

Request fundamentals	**Value of the demand by Lusoponte**	**Value of the pay by government**	**Payment mechanism**
FRA 1 – 24/03/1995			
• No increase in tolls • August exemption • Increase in the project risk due to protests	€ 90.4 M	€ 90.4 M	Direct compensation
FRA 2 – 23/09/1996			
• No increase in tools	€ 4.9 M	€ 4.9 M€	Direct compensation
FRA 3 – 17/02/1997			
• Exemption in August of 1996 and 1997	€ 4.9 M	€ 4.9 M	Direct compensation
FRA 4 – 22/02/1999			
• No increase in tools • Exemption in August of 1998	€ 63.2 M	€4 .9 M	Direct compensation
FRA 5 – 03/03/2000			
• No increase in tools • Exemption in August of 1999	17.9 M€	17.9 M€	Direct compensation

Table 7 – Dynamics of negotiation towards the global agreement

This table presents the initial agreement's conditions that were changed in the 2001 global agreement. Source: own table, based on Court of Audits information.

Conditions	Initial agreement	2001 Global agreement
Tools	Two bridges with the same tool price	Pricing difference between the two bridges
Commercial policy	Non-existent	Frequent user discount
Tax benefits	Non-existent	Changes in the recognition of revenues, reduction in corporate income tax
Concession period	Up to 2.25 million vehicles	2030
Claw-back	Non-existent	Non-existent

Table 8 – Renegotiations

This table presents the main features in both renegotiation case studies. Source: own table

Characteristics	Fertagus	Lusoponte
Event (s) that lead to renegotiation	▪ Demand below initial forecast	▪ Government decisions to not increase tolls price or end august exemption in '25 Abril' bridge
Renegotiation request by	▪ Private	▪ Public
Nº renegotiations	▪ 1	▪ 7
Renegotiation period (s)	▪ 2001-2004	▪ 1995-2000 ▪ 2001 ▪ 2007
Changes in contract	▪ Deleverage of Fertagus balance-sheet ▪ Change in demand risk ▪ Claw-back mechanism	▪ From 1995 to 2000, public financial compensations ▪ In 2001 (global agreement): • Change in toll prices • Increase in concession period • Financial compensation • No claw-back
Did project risk change, and how?	▪ Yes, reduce	▪ Yes, reduce
Did project profitability change, and how?	▪ Yes, reduce	▪ No
Public sector financial support	▪ € 80 M	▪ € 500 M
Renegotiation outcome	▪ Concession remain open ▪ Good performance and service quality ▪ After 2010, concession became financial viable ▪ Public sector has shared the gains above the base case, after renegotiation	▪ Public funds support most of the investment ▪ Additional benefits were totally captured by private sector ▪ Doubts about the efficiency in this PPP

Chapter 3

Renegotiating Public-Private Partnerships

ABSTRACT

The renegotiations of public–private partnership (PPP) contracts are commonly considered to be one of the pitfalls of PPPs, as they tend to undermine their (ex ante) efficiency. A renegotiation occurs when specific events change the conditions of a concession, frequently leading to a financial claim from the private sector on the public sector. This paper examines the Portuguese experience with PPP renegotiations by means of a unique panel data of 254 renegotiation events from 1995 to 2012. We find evidence of opportunistic bidding for PPP contracts, which is ex post – after the contract is won and the competition eliminated - leading to renegotiations to increase revenues. Renegotiations last on average 1.8 years. Majority governments are more prone to renegotiate and have more political clout to limit the renegotiation duration. There is no evidence of more renegotiations in election years or when there is a change in government. A better institutional framework, defined as a low country risk, a strong rule of law, and lower corruption, tends to reduce the probability of renegotiations. There is also evidence that at times of higher corruption, more renegotiations occur. The project's leverage decreases the renegotiation duration. Strong initial bidder competition for a PPP contract leads to long subsequent renegotiations between the winning private party and the government.

KEYWORDS: Public–Private Partnerships; Concessions; Renegotiations

JEL codes: G38; H54; L51

1. Introduction

Over the last few decades, PPPs have been increasingly used by governments around the world to finance and manage complex (infrastructural) operations. In this sense, PPPs can be described as "…an agreement between the government and one or more private partners (which may include the operators and the financiers) according to which the private partners deliver the service in such a manner that the service delivery objectives of the government are aligned with the profit objectives of the private partners and where the effectiveness of the alignment depends on a sufficient transfer of risk to the private partners" (OECD, 2008, pg.17). In this way, PPPs are long-term contracts (typically 30–40 years) whereby the private sector assures the construction of infrastructure or provides a service. Public–private partnership (PPP)

contracts have frequently been subject to renegotiations. Renegotiations occur when specific events – often referred to 'compensation events' - change the financial conditions of the concession. This is mainly the case when the public authority has to compensate the project company for a loss of revenue or unanticipated additional costs. A change in compensation usually occurs in three situations when a renegotiation is initiated by the government: (i) the public sector requires a change in the contract (unilaterally), (ii) the public sector's actions create a liability to the project company, and (iii) a change in a law occurs which affects the profitability of the project (Yescombe, 2011). Alternatively, renegotiations can be initiated by the private sector and this is mainly the case when the concession's financial conditions deteriorate in such a way that the private company may slip towards bankruptcy. The solution is then some additional financial compensation or a revision of the concession terms (e.g. increasing prices, reducing investments or lowering operational costs by reducing service requirements).

Given a high degree of uncertainty in these long-term PPP contracts, provisions are included regarding the possibility of future renegotiations in case specific events would arise. One of criticisms on PPPs is that the high rate of renegotiations undermines the credibility of the initial bids by the private sector for PPP projects as the bidding parties may expect renegotiations (that tilt in their favour) which affect the bidding competition and the efficiency of PPPs. Furthermore, renegotiations impose an additional burden on the public budget. PPPs also have particular characteristics that make them more prone to renegotiations, as they are long-term, complex, and incomplete contracts. In addition, they occur in heavily regulated sectors that are sensitive to political and circumstantial changes. These factors combined with the high levels of investment result in larger uncertainty. Therefore, the understanding of the renegotiation process is a key aspect of the ex-ante PPP contracting. Only few (geographically disperse) studies have touched on this subject, which calls for more research.

PPP renegotiations on South-American PPPs were examined by Guasch, Laffont, & Straub (2003) who identify the renegotiation determinants. The find that a stronger institutional, political, and legal environment providing contractual security, reduces the probability of future renegotiations, whereas an increase in the level of corruption, elections (bringing different political parties to power), or higher required follow-up investments tend to increase the probability of renegotiations.

Since 1993, Portugal has been a leader in the use of PPPs (as a percentage of GDP) with 35 PPPs to date. According to Sarmento (2010), the main incentive for the government to adopt this intensive use of PPPs was the "off-balance sheet advantage". By using PPPs rather than traditional procurement, the Portuguese governments were able to build a large infrastructure without increasing the public expenditure and, thus, the deficit and national debt at the moment

of construction.[1] The majority of PPPs in Portugal involved the road sector, accounting for 22 projects and 80% of total PPP investment, while PPPs were also used in the railway sector, health care, and security.

Despite their prevalence, there has been little discussion or investigation into PPPs in Portugal. Only two studies based on a sample of 87 companies focus on the Portuguese experience with renegotiations: one at the state central level (Cruz & Marques, 2013b) and the other at the local government level (municipalities) (Cruz & Marques, 2013a). They conclude that the concession duration, the investment, and the existence of a regulator are correlated with the probability of renegotiations.

The intensive use of PPPs over the last two decades makes the Portuguese experience an interesting study object. This entails that we have a sufficient number of observations (in contrast to earlier more descriptive research) to quantify the renegotiation probability and motives (by means of probit, multinomial logit, and duration models).

This paper presents a comprehensive analysis of PPP renegotiations and aim to answer three questions: (i) How does the PPPs renegotiation process work? (ii) What determines the probability of PPP renegotiation? and (iii) What is the average duration of a renegotiation event and its determinants?

In relation to the first question, we have collected data on 254 renegotiations events between 1995 and 2012, the vast majority of which is in the road sector. About 75% of the all the PPPs were renegotiated at least once. On average, the first negotiation occurs 3.5 years after the concession was awarded. Renegotiations generally occur for several reasons, particularly for "specific legal changes" (i.e., a government changes legislation or the regulatory framework affecting only the specific sector of the PPP and not general legislation affecting the concession), the costs of archaeological findings (construction delays, changed building plans), and additional (contractually unforeseen) work requiring more investments. The abnormally high frequency of renegotiations raises the question as to whether renegotiations should be regarded as natural and typical aspect of the PPP or they induce a substantial disadvantage of the PPP procedure relative to procurement as they drive up the costs for the government.

To answer the second question, we find that some concession variables have an impact on the probability of renegotiation. According to our results, PPPs not yet renegotiated are more likely

[1] The EU rules for PPP accounting (in national accounts), is that PPP investments will not count for the deficit and debt, as long as the private sector holds the construction risk and one of two risks: availability risk or the demand risk. Availability risk means that the private company will be paid as long it provides the availability of the asset or service, independently of the volume of utilization. Therefore, during the construction stage, there is no impact on the public finances. Later, at the operational stage, the public payments are expenditures (registered as intermediate consumption), increasing the deficit and the debt.

to be renegotiated than previously renegotiated PPPs undergoing further renegotiations. PPPs in the operational stage are more likely to renegotiate. Renegotiations occur more frequently when the number of initial competitors was higher, which may reflect more aggressive bidding. It could be that the winning company has made too low a bid or underestimated the costs, possibly anticipating a renegotiation at a later stage when the competition would have been eliminated. Election years (and their lags and leads) and a change in government appear to have no impact on renegotiations. Conversely, majority governments tend to enter renegotiate more often, as they have more power and face less scrutiny than governments which only have minority support in Parliament. We also report that a better economic and legal framework also reduces the odds of renegotiation. A larger degree of economic corruption is correlated to more frequent renegotiations, as governments will be more prone to satisfy private demands.

Regarding the third question, we find that a renegotiation event has an average duration of 1.8 years. Concession age, contract duration, and leverage all reduce the duration of each renegotiation event, whereas the number of initial bidders, the size of the capital expenditure, and PPPs in the operational stage increase the renegotiation duration. Renegotiations in the year after elections reduces the duration which is also the case when a right wing government renegotiates. Majority governments make quicker decisions. Finally, there is some evidence that an improvement in the economic and legal environment (such as a lower country risk or lower corruption) tends to make renegotiation last longer. This finding could be explained by the fact that a better prepared public sector may be more likely to defend the public interest, extending the renegotiations for that purpose.

This paper is organised as follows: Section 2 provides a literature review on renegotiation. Section 3 presents the methodology and data. The Portuguese PPP renegotiations are discussed in section 4, and the econometric results are presented in section 5. Section 6 presents the conclusions.

2. Literature Review

2.1 Public–Private Partnerships

Many PPP agreements occur in regulated markets that are politically sensitive. PPPs require that project risks are shared between the public and private sectors. During the contract period, the government or the users or both will pay for the asset or service. The payments from the government to the PPP are usually fixed at the beginning of the contract. However, as we will

observe, possible renegotiations can create uncertainty regarding future payments and government liabilities.

The use of PPPs has generated much criticism, some related to disappointing efficiency, (Glaister, 1999; Shaoul, Stafford, & Stapleton, 2006), constraints in competition (Bovaird, 2004), or lack of accountability (Broadbent & Laughlin, 2003; Froud, 2003; Asenova & Beck, 2010). However, the two main points of criticism relate to the fact that PPPs tend not to yield value for money (VfM) and that PPPs are initiated by "off-budget temptations" (Grimsey & Lewis, 2005). In many cases, PPPs do indeed not yield VfM, meaning they do not provide the required quantity and quality of services at a lower overall cost (i.e., the whole-of-life cost to meet the user requirements) (Ball, Heafey & King, 2007). The temptation to deliver a public service through a PPP relates more to budget limitations than to efficient public procurement, especially when fiscal constraints are binding. PPPs postpone the required public investment, and as such do not affect a government's current deficit and debt, and avoid budget restraints.

A further criticism relates to the fact that PPPs tend to be frequently renegotiated. In fact, a long concession period, risk sharing, political change, and the sensitivity of regulated markets all substantially increase uncertainty to all stakeholders (Chan, Levitt & Garvin, 2010). Renegotiations have become a major issue in PPPs, but the literature on this topic is scarce.

2.2 PPP renegotiations

Renegotiations can be defined as a revision of the concession contract, affecting and altering the financial balance of the project firm (Guasch, Laffont, & Straub, 2007). However, changes that are anticipated in the contract, such as tariff adjustments for inflation, are not considered renegotiations. Only when substantial departures from the original contract occur and the contract is then amended, can it be said that a renegotiation has occurred. However, renegotiations may also stem from opportunistic behaviour from one of the parties, as bidders for a PPP contract who assume that renegotiations may occur, may bid more aggressively (Williamson, 1989). Subsequently, when the concession has been awarded, renegotiations can occur without further competition from the other bidders. In this way, an opportunistic bidder could seek renegotiation to compensate for his initial under-bidding (Guasch, 2004). An opportunistic bidder may be in a strong position because in most cases, the interruption of the public service is unacceptable because of the social or the political costs, leading to a compromised negotiation position for the government. The opposite could also occur when governments try to interfere with contract clauses, such as in the Lusoponte case-study where the government decided to abolish the increase in tariffs that had been stipulated in the PPP

contract (Sarmento & Renneboog, 2014b). In some renegotiations, the public sector could hold a lot of bargaining power, mainly when the private company is in a difficult financial condition and bankruptcy would have a significant impact on the shareholders (either financially or in terms of reputation).

Renegotiations are considered to be one of the pitfalls of PPPs for two reasons: the abnormal frequency of renegotiations (especially shortly after they have been awarded) (Schwartz, Corbacho & Funke, 2008) and the fact that they are viewed as a source of distress in the efficiency of PPPs (Guasch & Straub, 2006). Therefore, in the beginning of the partnership, the public sector must take into account the possibility of renegotiation over the lifetime of the concession and should clearly state in the concession contract what conditions and events can initiate a renegotiation. Whereas some authors consider a renegotiation event as a PPP failure (Froud & Shaoul, 2001; Jamali, 2004), others consider it a natural and typical process in PPPs (Engel, Fischer, & Galetovic, 2009). PPPs have several characteristics that make them more prone to renegotiations: they are long-term, complex, and incomplete contracts occurring in heavily regulated sectors that are sensitive to political and circumstantial changes, require a high level of investment, and have a high level of uncertainty. Estache, Guasch, & Trujillo (2003) identified several reasons for renegotiation: optimistic base-case scenarios, debt finance difficulties or high levels of leverage, interest rate changes, currency risk, and incorrect risk allocation.

The issue of incomplete contracts is unavoidable as no contract can include every possible contingency. Furthermore, some events have such a low probability of occurrence that the cost of trying to exhaustively include all such events in a contract is prohibitively expensive. Moreover, a more complex contract would reduce the transparency in the use of public money.

An additional important determinant is the country's legal and political environment. The quality of regulation and regulatory bodies, along with the legislative and the rule of law, constrain the probability and scope of renegotiations. The pressure of forthcoming elections could also affect renegotiations.

2.3 The main PPP renegotiation studies

Unlike contract renegotiation theory (e.g., Grossman (1986); Williamson (1989); Tirole (1999); Hart (1990); Hart (2003)), the literature on PPPs (and particularly on renegotiations) is not abundant because private firms rarely share information on their agreements and are even more unlikely to share information about their renegotiation decisions and outcomes. For this reason, the few empirical studies on renegotiations mainly address government procurement (De Brux,

2010; De Brux, Beuve, & Saussier, 2011). The main study on (South-American) PPP renegotiations is by Guasch et al. (2003) which they subsequently expanded into several papers.[2] These studies incorporate variables that capture both the contract clauses and the characteristics of the economic and institutional environments. In the 2003 study, 1,000 South-American concessions were analysed over a period of nearly 20 years. Approximately 75% of the PPPs in transportation were renegotiated as were 90% of the water and sanitation PPPs. Guasch et al. (2003) reports that the existence of a regulator and better institutional quality reduce the probability of renegotiation, but GDP growth, additional investments, upcoming elections, and a reduction in the corruption level increase it. A regulatory body reduces the effect of contract incompleteness by leaving less room for mistakes and uncertainties. These results are confirmed for French PPPs by De Brux et al. (2011).

Guasch & Straub (2006) and Guasch, Laffont, & Straub (2007) differentiate the probability of firm-led and government-led renegotiations, confirm the importance of the above variables. They also show that additional investment requirements and corruption positively affect the probability of public sector renegotiating (with a negative impact on the private sector) and that exclusive private financing has a positive impact on the probability of the private sector renegotiating (and a negative impact on the public one).

Engel, Fischer & Galetovic (2009) study PPPs in Chile and find evidence that in a competitive market, firms lowball their offers, expecting to break even through renegotiation, while governments use renegotiation to increase spending and shift the burden of payments to future administrations. Reside Jr, & Mendoza Jr (2010), analyse PPP renegotiations in Asia and report that approximately 70% of PPPs are renegotiated because of currency risk, as the investments are paid in a different currency than the one for revenues and expenditures. While in the Latin-American experience, the outcome of renegotiations was generally a tariff increase, the outcomes in Asia usually consisted of increased subsidies and financial compensation. Menezes & Ryan (2013), show that the winning firm (with the lowest bid) are more likely to require a subsequent government bail-out and more able to extract additional transfers from the government.

The key issue is how to design better concession contracts, inducing both parties to comply with the agreed initial conditions. That way, the probability of renegotiation will be reduced, along with opportunistic behaviour by both parties.

[2] (Guasch, 2004; Guasch et al., 2007, 2008; Guasch & Straub, 2006, 2009).

2.4 Endogeneity of PPP contracts in renegotiations

The potential endogeneity of PPP contract design and subsequent renegotiations is a critical issue. Guasch et al. (2003) and Guasch & Straub (2006), state that contract endogeneity in PPPs comprises two problems: an ex-ante self-selection problem and an ex-post moral hazard one. The former arises because each party tends to choose specific contract clauses that are advantages to them given their own characteristics. For instance, a self-selection effect could make more efficient firms prefer price caps, which is more risky but also more profitable. The latter problem emerges when both parties act strategically according to the structure of the contract. For instance, shorter contracts may provide an incentive to firms to be more efficient as they seek to renew the concession. For longer contracts, a minimum income guarantee could induce firms to be more indolent in their efforts to be more efficient.

Guasch et al. (2003) use as endogenous variables several contract conditions, such as the use of price caps, projects exclusively financed by the private sector, the existence of an arbitration process and a bidding procurement process, the existence of a minimum income guarantee (reducing private sector risk on revenues), and the duration of contracts. The instrumented variables were the sector, corruption, bureaucracy quality, rule of law, and the existence of a regulatory body. All endogenous variables increase the occurrence of renegotiations, with the exception of the bidding procurement process (which reduces the occurrence of renegotiations) and the arbitration process (which has no significant impact on the occurrence of renegotiations). This study was complemented by Guasch et al. (2007); Guasch, Laffont, & Straub (2008), and Guasch & Straub (2006, 2009), who focused on the determinants of government-led renegotiations and found largely similar results (but corruption was shown to have an impact on increasing renegotiations).

De Brux et al. (2011) analyses the impact of renegotiations in the renewal of PPP contracts in the French parking sector. They use contract experience (a proxy for public sector experience in contractual agreements, less prone to renegotiations), political colour, and the change of the mayor as instruments for the average number of renegotiations. The authors conclude that only contract experience is a good instrument.

3. Methodology and Data

3.1 Methodology

The renegotiations examined in this paper occurred over the period 1995 to 2012. Of a total of 35 PPPs, 26 were renegotiated at least once and the total number of renegotiation events amounts to 254. The data were hand-collected from 35 reports (one for each PPP) from "Direcção Geral do Tesouro e Finanças" (DGTF), the ministry of finance department responsible for managing and monitoring PPPs in Portugal.

We gathered from each report data on each PPP project's renegotiation events, the year of the renegotiation request, the request's motive, and the time of renegotiation completion (with as final date the end of 2012). Details given in Section 4.

To examine the main determinants that affect the probability of a renegotiation we apply the following estimation methods:

Probit (and logit) models on panel data whereby each year (our dependent variable) is labelled as either a renegotiation or no-renegotiation year. Specifically, we assume that the model takes the form: Pr $(Y = 1 \mid X) = \phi\,(X'\beta)$ (1), where Pr denotes the probability, and Φ is the cumulative distribution function of the standard normal distribution. The parameters β can be estimated by maximum likelihood. It is possible to motivate the probit model as a latent variable model. Suppose there exists an auxiliary random variable: $Y* = X'\beta + \varepsilon$ (2) where $\varepsilon \sim N(0, 1)$. Thus, Y can be viewed as an indicator for whether this latent variable is positive:

$$Y = \begin{matrix} 1\ if\ Y* > 0\ i.e - \varepsilon < X'\beta \\ 0\ otherwise \end{matrix} \quad (3)$$

In this model, the 254 renegotiation events take the value of 1. Non-renegotiation years take the value 0 and are the years in which the 26 PPPs were not renegotiated as well as all the concession years of the 9 PPPs that were never renegotiated. We have 175 non-renegotiation years and hence a total of 428 observations. We used a random-effects and population-averaged probit model, allowing us to cluster of standard errors at the PPP (project) level.

We also estimate a multinomial logit model, with the motives for the renegotiation as dependent variables. Motive 1 captures the public sector reasons, i.e.: specific legal changes, corporate tax increases, administrative delays, contract changes, and changes in environmental requirements; Motive 2 represents construction motives i.e.: archaeological findings, additional work/investments, delays in expropriations, and construction overruns, and Motive 3 represents

the operational and major cause motives (low demand, major cause events, also called "Acts of God", global agreement, additional financial compensation, and other events).

Finally, we also apply a duration model (Cox Proportional-Hazards semi-parametric model) with as dependent variable the length of time of each renegotiation. In this model, Y_i denotes the observed time (either the censored time or the event time) for renegotiation i, and let C_i be the indicator that the time corresponds to an event (i.e., if $C_i = 1$, the renegotiation occurred, and if $C_i = 0$, the time is a censored time). The hazard function has the form: $\lambda\,(t|X) = \lambda o(t) \exp\,(\beta 1X1 + \cdots + \beta pXp) = \lambda o(t) \exp(\beta' X)$ (4).

The hazard function consists of two parts in multiplicative form: the baseline hazard, which is a function of the duration time, and a part that is a function of the explanatory variables and the associated parameters (Gujarati, 2011).

3.2 Description of the data

The probability of a renegotiation can be affected by characteristics of the project and the PPP contract, the country's political environment and constraints, and the country's economic and legal environment. We partition our variables into these five groups (and define them below):

(1) Sector (roads, railways, health care, and security);

(2) Concession characteristics: if the concession has never been renegotiated before (if this event is the first renegotiation), the concession age at the moment of each renegotiation event, the PPP stage (construction or operational stage) at the time of renegotiation, the availability payment, the main shareholders (foreign or domestic investors), the Ascendi Group (the most relevant actor in the PPP market with strong political ties), the contract duration, the investment, the number of bidders, the size of the loans from the EIB, and the debt in the PPP firm as a percentage of capex;

(3) Political variables: the electoral years (indicator variables) and their lags and leads; the dominating political party in government (right or left wing); a year with a change in government; and whether the government has a parliamentary majority;

(4) Legal variables: the composite risk rating, the contract's viability, the legislative strength, the political risk rating, the corruption index, and the time period before and after the 2006 PPP law, and;

(5) Macroeconomic variables: GDP growth, the size of the national deficit and public debt as a percentage of GDP.

First renegotiation is 1 if the renegotiation event is the first PPP renegotiation and 0 if it is a subsequent renegotiation. PPPs never renegotiated should be more prone to renegotiation during the life-time of the concession.

Concession age represents a PPP's total number of years, beginning with the contract day and ending with the renegotiation request. During the life-cycle of a PPP, the probability of renegotiation may increase for two reasons: with the passing of time, PPPs are more prone to renegotiation because the initial forecast tends to be less accurate in the long term and the projects are more subject to instability. Therefore, we expect concession age to be positively related to the probability of renegotiation.

Operational stage equals 0 when the renegotiation occurs during the construction stage, and 1 during the operational stage. A renegotiation is expected to occur more frequently during the operational stage for two reasons: this stage is the longest part of the concession period and embeds most uncertainty.

Availability payment equals 0 if a payment to the PPP is based on service (demand) and 1 if the payment is based on availability. A PPP availability payment consists of a fixed annual rent, as long as the asset is in condition to be used according to the contractual requirements. This type of payment is expected to decrease the probability of renegotiation because the demand risk has been allocated to the public sector. Therefore, there is a lower uncertainty regarding the long-term projections on revenues for the private party, which reduces its cost of capital.

The *Foreign shareholders* variable is 0 if the majority of the equity capital is owned by domestic companies and 1 if the majority is owned by foreign companies. A foreign share stake majority may decrease the probability to renegotiate.

Ascendi captures whether the PPP belongs to the Ascendi Group (equal to 1) or not (equal to 0). Ascendi is the largest group actively involved in Portuguese PPPs and has strong political ties, which strengthens its negotiations power.[3]

Contract duration is the length of each PPP contract. Longer concessions are likely to be renegotiated more frequently due to the imprecision of long-run forecasting.

[3]The Ascendi Group plays an important role in the road sector and belongs to two of the largest economic groups in Portugal: Mota-Engil, a large construction company, and BES, one of Portugal's leading banks. Therefore, the importance of Ascendi and its political relationships makes it a relevant variable to study in renegotiations. Of the 35 PPPs, Ascendi accounts for 6 (all in the road sector). Of the 254 renegotiations events, Ascendi accounts for 89.

Investment stands for the total investment required for each PPP. The higher it is, the higher is the risk for the owners of and lenders to PPPs. Large infrastructural projects are subject to more uncertainty regarding possible overruns in costs, especially during the construction period (Bruzelius, Flyvbjerg, & Rothengatter, 2002; Flyvbjerg, Holm, & Buhl, 2002). In this regard, the level of investments also increases the probability of renegotiations.

Number of bidders stands for the number of companies that take part in the bidding for the project. Strong competition at the bidding phase could lead to underbidding which increases the probability of renegotiations. This may be due to the winner´s curse in that renegotiations can be viewed as the consequence of aggressive bids, with opportunistic behaviour on the part of some bidders who believe they will be able to renegotiate later so as to compensate their initial losses (Hong & Shum, 2002).

Debt/Capex is the percentage of the investment financed by debt (the project's leverage) and *EIB* is a dummy variable indicating whether the EIB has financed part of that debt. A high debt percentage represents the risk for the banking sector, which could increase the probability of renegotiations. Additionally, a high level of debt, despite being common in project finance can expose the project to shocks and crises in the financial markets, with consequences for the cost of debt and the financial sustainability of the project (Sarmento & Renneboog, 2014a). The presence of the EIB is expected to improve the project's financial conditions, borrowing rate, and sustainability, and thus reduce the probability of renegotiation. The EIB has played a very important role in PPP finance in Europe, particularly in Portugal. The bank not only offered loans at a lower interest rate than the market but also lends at longer maturities. As the EIB also provides expertise and renders international credibility to the PPP program and is thus an important factor encouraging international banks to participate in PPPs. Thus, we expect the presence of EIB loans to reduce the probability of a renegotiation.

Election year (at t, t-1, and t+1). In an election year (or the year before), the number of renegotiations may increase as private parties may then find a more indulgent government.

A *right wing government* may be more prone to renegotiate, as they may have better ties with private sector than a socialist government.

Change in government is an indicator variable equal to 0 if after an election the government did not change (the governing political party remains in office) and 1 if there was a change in government.[4] A new government can reconsider previous government's decisions, either due to new priorities or political motives, and thus commence renegotiations of PPPs.

[4] Years with a change in government: 1995, 2002, 2005 and 2012.

Majority Government equals 1 if the government at the time of renegotiation has a parliamentary majority (and equals 0 if not).[5] A majority government has more clout when conducting negotiations and could possibly negotiate with a lower degree of transparency (Cruz & Marques, 2013b). Hence, this variable is expected to be positively correlated with the probability of renegotiation.

Risk rating, contract viability, political risk, and rule of law proxy for the quality of contract (enforcement). These variables are dynamic, with the values ranging from 0 to 10, or 0 to 100. An increase in the score signifies an improvement in the country's situation. Risk rating is a composite of political, financial, and economic risk, measuring the relative position of a country in these areas. Contract viability represents the risk of unilateral contract modification or cancellation and, at worst, outright expropriation of private owned assets. Political risk captures a country' political stability. A more stable political situation is expected to reduce the probability of renegotiations, as there is less room for opportunistic behaviour from either the public or the private parties. Rule of law represents the quality and strength of the legal system: it shows the judicial limits of government to realize its policy program through the legislative arm of government. Better enforcement is expected to dissuade or reject inappropriate claims for renegotiations.

Corruption is a dynamic variable ranging from 0 to 10 (with 10 being the lowest corruption).[6] If operators believe that the governmental decision making is subject to influence, the odds for renegotiations as a way to capture additional rents may increase (Kaufman, Kraay & Zoido-Lobatón, 1999).

2006 PPP law is 0 if the renegotiation has occurred before the approval of the 2006 PPP law and 1 subsequently. The first PPP law in Portugal was created in 2002, and established the general regime regarding the concept, preparation, bid, adjudication and monitoring of PPPs. However, there was an absence of regulatory and sector framework regarding renegotiations until this law was amended in 2006. This was done with the objective of increasing cooperation among public sector entities and improve the mechanism of controlling PPPs. Additionally, several dispositions regarding the renegotiation process were changed, particularly the negotiation procedures and mechanisms to share the benefits between public and private sector. This way, the law is expected to strength the legal ground for PPPs and hence to weaken the probability of renegotiations for both parties.

[5] The years with majority governments are 2002 through 2009.
[6] The Corruption Perceptions Index ranks countries based on how corrupt their public sector is perceived to be. A country/territory's score indicates the perceived level of public sector corruption on a scale of 0 to 10, where 0 means that a country is perceived as highly corrupt and 10 means that it is perceived as very clean (source: Transparency International).

GDP growth can influence infrastructural investments as macroeconomic shocks could increase the likelihood of the renegotiation of contracts.

Deficit and public debt are given as a percentage of GDP. High deficit and debt could increase renegotiations for two reasons: First, renegotiations can enable governments to circumvent budgetary rules by postponing expenditures. Second, there is a binding budget constraint in Portugal due (in part) to the intensive use of PPPs (Sarmento & Renneboog, 2014a). Furthermore, governments may focus on fiscal objectives rather than efficiency.

Table 1 summarises the independent variables in this study, and indicates their expected signs. Table 2 exhibits their descriptive statistics. The Breusch–Pagan test for heteroskedasticity rejects the null hypothesis. The Jarque-Bera test on variables' normality is statistically significant, meaning that we can safely consider that the data have a normal distribution.

[Insert Table 1 and 2 here]

4. Results

4.1 Descriptives of PPP Renegotiations

We answer the first research question: How does the PPP renegotiation process work? Portugal´s first PPP concerned the construction of the "Vasco da Gama" bridge (1999-2002 and 2008-2010), which was followed by another 34 PPPs. The majority of these projects have been in the road sector (22 projects), with others in the health (10), railway (2), and security[7] (1) sectors. A total of €20 billion was invested by the private sector over the past two decades. The large number of projects and investments implies a large amount payments to the private sector over the coming decades. Between 2014 and 2020, annual payments represent 1% of GDP; from 2020 to 2035, annual payments are expected to decline to a still sizeable 0.5% of GDP. Using the discount rate used by the public sector (6%), the annual payments for the next 30 years represent a net present value which approximately amounts to 10% of the current GDP (2014). The high concentration of PPPs signifies that Portugal is a world leader in PPPs according to Sarmento & Reis (2012), which is confirmed when comparing the data on the amount invested in PPPs up to 2011 from the EIB with the GDP figures from 1995 to 2011 for each European country. We observe from Figure 1 that Portugal is by far the leading country in terms of PPP.

[Insert Figure 1 here]

[7] The security project regards the communications infrastructure of the police force.

For the road sector PPPs, a high degree of scepticism regarding their VfM has arisen. The profitability of the concessions, the conditions of renegotiation and financial rescues, and the high level of public payments have laid the basis for such doubts.

Along with the burden that the PPP contracts place on the public sector, one also needs to consider the rapid pace at which these contracts were created. They were often established without ensuring that the public administration would be capable of managing them. The novelty of the PPP model added to the fact that the Portuguese government was not prepared for the level of complexity of these contracts, and has led to a number of questionable decisions. In addition, until 2003, there was no proper legal framework for PPPs and, until 2006, there was no legal PPP renegotiation framework. All this made the Ministry of Finance behave passively in terms of PPP follow-up. Given that Portugal was financially rescued by "the Troika" (the EU, ECB, and the IMF) in 2008, the adjustment program has included specific measures regulating PPPs (Sarmento & Reis, 2012). The renegotiation rate surged since the financial crises and the economic recession started in 2008 (Figure 2). From the 254 renegotiation events, the road sector accounted for 233, the railway sector for 17, the security sector for 3, and the health sector for 1 (Table 3,Panel A). A significant number of renegotiations took place during the operational stage (171 events, 155 of which were in roads). A large number of renegotiations were requested in a government election year (117 events, of which 112 were from roads). At the end of our sample period (end of 2012), 82 of the 254 renegotiation events were accepted, 5 were rejected, and 167 are still under negotiation. As most renegotiations end with a financial compensation to the private company, the future liabilities for the Portuguese government have surged. Forty-three per cent of PPPs were renegotiated in the first 3 years (15 concessions out of a total of 35), and 57% in the first 4 years. A first renegotiation in a PPP takes place on average after 3.5 years since the signing of the PPP contract (see Table 3, Panel B).

[Insert Figure 2 and Table 4 here]

Table 4 (panel A) categorizes the renegotiations by motive and sector. We observe that a substantial part of the renegotiations are initiated by the public sector, and follow legal changes, increases in taxes, or administrative issues. Unforeseen events, such as archaeological findings and major cause events are also an important source of renegotiations. The 14 renegotiation triggered by low demand in the railway sector result mainly from the MST project (the South Lisbon light railway) and Fertagus (the rail project on the Lisbon bridge) (Sarmento & Renneboog, 2014b). The average time between the PPP contract and the first renegotiation event is 7 years. When we only consider the 155 renegotiation events that occurred during the operational stage, the average time for renegotiation is 6 years with a standard deviation of 3.3 (see Table 4, Panel B)

[Insert Table 4 here]

Relative to the Latin-American PPPs (Guasch, 2004), Portugal has a disproportionally high percentage of renegotiations (253 renegotiation events for 35 Portuguese PPPs versus 162 events for 307 Latin-American PPPs).

4.2 Determinants of PPP renegotiations

To answer our second research question regarding the determinants of renegotiations, we run a probit model with and without year effects (Table 5). This model was run using just the road sector, with similar results. Renegotiations most frequently occur in the road sector, relative to the other sectors.

Out of the concession variables, the First renegotiation, Operational stage, Number of bidders and Debt/Capex have a statistically significant impact on the probability of renegotiations. The operational stage comprises the larger part of the concession period and embeds the most uncertainty. As expected, the significance of the Number of Bidders suggests that strong initial bidding competition increases the likelihood of underbidding, such that the resulting losses are expected to be recuperated in subsequent renegotiations. High project leverage is expected to make the project's financial stability weaker such that renegotiations are more likely. However, project leverage has a negative sign. The above results from model 1-7 of Table 5 are confirmed by model 8 which includes year-fixed effects.

While the election years (and their leads and lags) and change in governments do not influence the renegotiation likelihood, other aspects of the political environment do. For instance, right-wing governments are more prone to renegotiate, what confirms our predictions. A government with a parliamentary majority has more political clout to renegotiate than a government facing strong opposition (a minority government only survives at the discretion of the opposition).

We then turn to the quality of contract enforcement, proxied by the following yearly indices Risk rating, Contract viability, Rule of law, and the Corruption index. Better enforcement should dissuade or reject inappropriate claims for renegotiations. An increase in these variables represents an improvement in the Portuguese legal and economic environment. Thus, we expect all of these four variables to be negatively correlated to the occurrence of renegotiations. We find that this is indeed the case for Contract viability, Risk rating, and the Corruption index: lower contract viability and more corruption augments the likelihood of PPP renegotiations. The fact is that the corruption index in Portugal has reduce, meaning an increase in the corruption and at the same time an increase in the number of renegotiations. For the Rule of law, we obtain

results opposite to our expectations. The 2006 PPP renegotiations law, appears to be inefficient in terms of reducing renegotiations. Finally, we note that a worsening macroeconomic situation (as captured by the level of public debt and GDP growth) can also induce more renegotiations.

[Insert Table 5 here]

4.3 Renegotiation motives

As we have observed in Table 4 (panel A), several possible motives, partitioned into public motives, construction reasons, and operational and major cause events are laying at the basis of the renegotiation process. We estimate the determinants of the relative importance of these motives by means of a multinomial logit model and show the results in Table 6[8].

The motives for renegotiating are not sector dependent. The concession age variable in specification (a) indicates that public sector motives (including specific legal changes, corporate tax increase, administrative delays, contract changes, and environmental requirements changes) are at stake in renegotiations of relatively young PPPs. Likewise, renegotiations occur more frequently for reasons of construction (archaeological findings, additional work, delays in expropriations, and construction overruns) for older concessions (specification (c)).

When testing public sector versus construction motives (specification (a)), we find that PPPs with demand payment are more likely to face renegotiations induced by the public sector (relative to negotiations for reasons of construction issues). This tendency is explained by the fact that a substantial number of renegotiations are started by a government decision to change tariffs (only affecting PPP with demand payments). The model also shows that when Ascendi is the private party in the PPP, public motives are negatively correlated with renegotiations (specification (b)). As Ascendi belongs to a major construction group, it uses the groups' knowledge and expertise to seek additional rents through efficiently managing operations. Somewhat surprisingly, Ascendi's political connections (reflected in the fact that several former members of government serve on its board) negatively affect the possibility of renegotiation due to political decisions (specification (b)).

When foreign shareholders have a majority of the equity in the PPP company, the main renegotiation motives are limited to operational and major causes (specification (c)). PPPs with

[8]We have performed several alternative tests: we have introduced the variables Contract viability, Political risk, Risk rating, GDP growth, Deficit, and Public debt, introducing one by one although the correlations between these variables are below .5. Given the high correlation between Contract viability and Political risk, they are included in separate models.

EIB finance face increased odds for renegotiation due to public sector motives (relative to construction and other motives, specifications (a) and (b)).

In addition, renegotiations occurring in the year prior to elections are much more likely to emerge as a result of construction motives (relative to public motives; specification (b)), of and operational motives (relative to construction motives; specification (c)). This may be because, with approaching elections, governments may be more willing to enter negotiations with the private partner, accepting their demands (for specific construction terms). Right wing governments are more prone to renegotiate for public sector motives: they more frequently initiate changes to PPP project possibly due to better contacts with the private sector. In addition, a majority government tends to favour renegotiations for operational motives but not for motives which are typical for the public sector or for construction reasons.

When corruption is high (note that the index is then low) and the rule of law is weak, fewer renegotiations are started for public reasons. It may be that, in times with high corruption, governments are more prone to renegotiate for motives that they not entirely control, as it is the case of construction and operational motives (where the private sector has more information and superior knowledge), providing this way additional rents to private sector. The above conclusions are upheld when we control for a set of legal variables such as the introduction of the PPP law in 2006, a contract viability index and a political risk index. The 2006 PPP law, which provides a framework for PPP contracting and monitoring, has induces more frequent renegotiations for public sector motives or for reasons related to the construction phase, rather than for reasons reflecting operational issues. An improvement in the legal environment such as better contract viability or lower political risk seem to encourage the government to renegotiate by invoking public sector motives and be more resistant to opening renegotiations for problems with construction or operations which usually provide additional rents to the private sector.

4.4 Renegotiation duration

The average duration of a renegotiation is 655 days (approximately 1.8 years). For the 74 completed renegotiations, the average duration amounted to 464 days. A histogram of the duration of the renegotiations process (including the non-completed ones) is displayed in Figure 3. To assess what determines the renegotiation duration period, we estimate a semi-parametric duration model (Cox-hazard model) and show the results in Table 7. Just as in table 5, we have also run this model using just the road sector sample, with similar results.

[Insert Figure 3 here]

The duration of renegotiation is negatively correlated with the age of PPP (Concession age) which reflects that for older PPPs the renegotiations are often finalized and that no new renegotiations start. Renegotiations are shorter in the construction phase of the PPP. Governments may hurry as they want to inaugurate the infrastructure and collect the political dividends. Negotiations are also longer when higher investments are required (capex), and are shorter when the contract duration is longer. Contract duration reduces the renegotiation because on short contracts a termination incentive exists for government to enter into new contracts without ongoing conflicts or future liabilities. When the number of bidders was high (which may have led to underbidding), more may be at stake in the subsequent renegotiations, which then last longer. A high debt burden generates sufficient pressure not to let renegotiations linger, while the fact that the operational stage has started, the investment level, and the number of bidders have the opposite effect. High project leverage is related to more condensed renegotiations because, as high leverage stands for higher bank risk, banks can exert more pressure to assure a fast resolution to the conflict, particularly if the resolution can affect the PPP financial sustainability, and consequently, the debt service. When we focus on the road sector (Panel B of Table 7), we note that for this sector negotiation last longer in case Ascendi is the private party of the PPP.

In the year after an election, renegotiations take less time (Panel A of Table 7). This contradicts our assumption that after election, the probability of renegotiation would increase, because newly elected officials may be more willing to negotiate. Right wing parties in government decrease the time of renegotiations. Given that they renegotiate more frequently and mainly for public sector motives, the short duration of renegotiations may reflect that right-wing governments have better ties with private firms or are more sensitive to their concerns. We have reported above that majority governments renegotiate more and we find in Table 7 that their renegotiations take less time. This results from the fact that they are more powerful than minority governments as they do not have to negotiate with the parliamentary opposition.

There is some evidence that an improvement in the economic and legal environment tends to make renegotiations last longer (Contract viability, Rule of law, and Corruption). This increase in the renegotiation duration may be explained by a better prepared public sector being more likely to defend the public interest and extend renegotiations for that purpose.

[Insert Table 7 here]

A survival duration (Kaplan-Meyer) analysis examines the isolated impact of specific variables. We observe that renegotiations in the road sector tend to last longer than in other sectors. Furthermore, we observe that PPPs in the operational stage have shorter renegotiations than those in the construction stage. In addition, PPPs with payments by users have shorter

renegotiations. Domestic shareholders and the Ascendi Group also have an advantage in terms of renegotiation periods. There is also some evidence that left wing governments renegotiate faster and that the 2006 PPP law did not reduce the duration of renegotiations.

5. Conclusions

This paper examines why so many PPPs are renegotiated. The rich Portuguese experience with PPPs and renegotiations enables us to answer three research questions: (i) How does the PPP renegotiation process work? (ii) What determines the probability of PPP renegotiation? (iii) What is the average duration of a renegotiation event and its determinants?

Of the 35 Portuguese PPPs, 26 were renegotiated with a total of 254 renegotiation events. Most of these events occurred during the operational stage, in election years, and mainly in the early years of the concession. This high incidence of renegotiations – even shortly after contract were signed - has a negative impact on both the PPP's performance and efficiency and could undermine the credibility PPP projects. Although changing circumstances could inevitably lead to renegotiating PPP contracts, the high incidence of renegotiations may be beyond permissible bounds. That there are still many renegotiations during the construction stage is surprising because this phase quickly follows the awarding of the contract (typically 3 to 5 years), and is less risky given that the costs are predictable. We distinguished between several renegotiation motives, including those primarily regarding the public sector (specific legal changes, corporate tax, administrative and environmental changes, and delays) and the construction stage (archaeological findings, additional works, and delays in expropriations).

During the construction phase, PPPs are frequently renegotiated, which can be explained by pressure from governments seeking to collect political benefits by opening the infrastructure or service. We also found evidence that aggressive bidding for PPP contract between several competitors occurs, which increases the likelihood of subsequent renegotiations. Some private companies may bid merely to win the concession at the detriment of future profitability, which they try to remediate in later years through renegotiations. However, after a first renegotiation, the occurrence of other renegotiations is less likely.

There was no conclusive evidence that the political variables, such as election years or a change in government, have any impact on renegotiations. Still governments with a parliamentary majority seem more prone to renegotiate PPPs, as they are in a more powerful position than minority governments. A right-wing government is more likely to enter renegotiations. Higher institutional quality (better contracts, rule of law, and less risk) tends to reduce the probability of renegotiations. The level of corruption (which fluctuates over the years) is a strong determinant of renegotiations. Greater corruption leads to more renegotiations as governments will be more

prone to satisfy private demands. The high incidence of renegotiations gives some evidence that there might be certain flaws in the contract design combined with the inadequate regulatory and weak economic and legal environment.

We show that PPPs with users' payment are more frequently renegotiated for political reasons, which is especially the case in the year prior to elections. Both findings can be related to the government's tendency to change the tariffs agreed to in the contract to obtain political gains. PPPs belonging to the Ascendi group are more likely to renegotiate as a result of construction rather than political motives. The reason is that as Ascendi belongs to a large construction group (which can use it knowledge to seek additional rents) and has strong political ties to use in that strategy.

A renegotiation process lasts on average for 1.8 years. Concession age, contract duration, and the project's debt ratio tend to decrease the duration of the renegotiation, projects in the operational stage, with higher capital expenditures, and a higher number of initial bidders have longer renegotiation durations. Furthermore, majority government are able to go for short renegotiations. In contrast, the duration is longer when there is an improvement in the economic and legal environment (e.g., improvements in contract viability, rule of law, corruption and GDP growth). The latter effects may be explained by the fact that a better prepared public sector may be more prone to defend the public interest and hence extending the renegotiations for that purpose.

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Table 1. Explanatory variables

This table lists the independent variables used in our models with their expected sign and the theoretical justification. Source: own variables and data.

Variable	Type	Definition	Source	Expected sign	Reasons
Sectors: railways, roads and security, health	Dummy	0 – No 1 - Yes	DGTF 2012 PPP report	+	Omitted category in models: health sector
Concession variables					
First renegotiation	Dummy	0 – No 1 - Yes	DGTF 2012 PPP report	+	Higher probability of renegotiation in PPPs never renegotiated before
Concession age	Discrete	Age of concession (in years) at renegotiation start	DGTF 2012 PPP report	+	The probability of renegotiation should increase with the time of the concession
Operational stage	Dummy	0 – Construction stage; 1 - Operational stage	DGTF 2012 PPP report	+	Higher probability of renegotiations in operational stage, due to more uncertainty
Availability payment	Dummy	0 – No 1 – Yes	DGTF 2012 PPP report	-	PPPs with availability payment have low risk and uncertainty (they do not assume demand risk), which reduces probability of renegotiations
Foreign shareholders	Dummy	0- National 1- Foreign	DGTF 2012 PPP report	-	Foreign shareholders renegotiate less than national shareholders, as the latter have more political influence
Ascendi group	Dummy	0 – No 1 – Yes	DGTF 2012 PPP report	+	Ascendi group renegotiates more because of Mota-Engil's and BES' (the shareholders of Ascendi) political influence
Contract duration	Discrete	Years	DGTF 2012 PPP report	+	The length of contracts increases uncertainty, which augments the probability of renegotiation
Investment	Continuous	log of capex	DGTF 2012 PPP report	+	Higher investment increases private sector risk and thus also the probability of renegotiation
Number of bidders	Discrete	Number of bidders	DGTF 2012 PPP report	+	A higher number of bidders increases possibility of opportunistic bidding, leading to subsequent renegotiations

Variable	Type	Definition	Source	Expected signal	Reasons
EIB loans	Dummy	0 – No 1 – Yes	DGTF 2012 PPP report	-	EIB presence improves project sustainability
Debt/Capex	Discrete	Percentage	DGTF 2012 PPP report	+	Higher debt, means higher bank risk, increases the probability of renegotiation
Political Variables					
Election year	Dummy	0 – No; 1 – Yes	Portuguese gov. site	+	Electoral years increase probability of renegotiation because of opportunistic behaviour by governing parties
Election year (t-1)	Dummy	0 – No; 1 – Yes	Portuguese gov. site	+	The year before an election increases probability of renegotiation because of opportunistic behaviour by governing parties
Election year (t+1)	Dummy	0 – No; 1 – Yes	Portuguese gov. site	+	After election, the probability of renegotiation may increase, because newly elected officials may be more willing to negotiate
Right wing government	Dummy	0 – Left; 1 – Right	Portuguese gov. site	+	Liberal (right wing) governments tend to renegotiate more with the private sector
Change in government	Dummy	0 – No; 1 – Ys	Portuguese gov. site	+	A change in government may lead to opportunistic behaviour by private sector, leading to renegotiations
Majority Government	Dummy	0 – No; 1 – Yes	Portuguese gov. site	+	A majority in government could lead to renegotiations as majority government is more powerful in decision making
Legal variables					
Risk rating	Discrete	Index (1-10, 10=best)	PRS Group	-	This index aggregates political, financial and economic risk. Better legal and regulatory environment reduces probability of renegotiation
Contract viability	Discrete	Index (1-10, 10=best)	PRS Group	-	This index provides the risk of unilateral contract modification or cancellation and, at worst, outright expropriation of foreign owned assets. A lower risk should reduce the probability of renegotiations
Rule of law	Discrete	Index (1-100, 100=best)	PRS Group	-	This index indicates the quality and strength of the legal system. A better legal system should reduce litigation. However, it is also possible that a better legal environment would give the private sector more confidence to demand compensation and pursue judicial claims

Variable	Type	Definition	Source		Reasons
Political risk rating	Discrete	Index (1-100, 100=best)	PRS Group	-	This index assesses the political stability of the country. A more stable political situation should reduce the probability of renegotiations
Corruption index	Discrete	Index (1-10, 10=lowest corruption)	Transparency international	-	Low corruption reduces probability of renegotiation
2006 PPP law	Dummy	0 – No 1 – Yes		-	This law is expected to provide a better PPP framework and regulatory environment, reducing the probability of renegotiation
Macroeconomic variables					
GDP growth	Discrete	Percentage	Portuguese Statistic Office	-	Economic growth decreases probability of renegotiation
Deficit	Discrete	Percentage of GDP	Portuguese Statistic Office	+	Higher deficits lead to more renegotiations, in order to postpone public expenditures
Public Debt	Discrete	Percentage of GDP	Portuguese Statistic Office	+	Higher public debt leads to more renegotiations, in order to postpone public expenditures

Table 2. Descriptive statistics

This table present the descriptive statistics of the variables used in this study. Source: own data and calculations. Source: own table.

Variable	Obs	Mean	Std. Dev.	Min	Max
Sector variables					
Road	428	0.80	0.40	0	1
Railway	428	0.08	0.28	0	1
Security	428	0.02	0.13	0	1
Concession variables					
First renegotiation	428	0.06	0.24	0	1
Concession age	428	6.15	3.94	1	18
Operational stage	428	0.69	0.46	0	1
Availability payment	428	0.39	0.49	0	1
Foreign shareholders	428	0.23	0.42	0	1
Ascendi	428	0.30	0.46	0	1
Contract duration	428	28.41	6.21	4	36
Investment	428	6.06	1.35	1.10	7.93
Number of bidders	428	4.40	1.86	1	8
EIB	428	0.68	0.47	0	1
Debt/Capex	428	68.94	21.19	14	97
Political					
Election year	428	0.42	0.49	0	1
Election year t-1	428	0.32	0.47	0	1
Election year t+1	428	0.35	0.48	0	1
Right wing government	428	0.47	0.50	0	1
Change in government	428	0.33	0.47	0	1
Majority Government	428	0.77	0.42	0	1
Legal variables					
Risk rating	428	72.92	3.99	68.50	85.50
Contract viability	428	3.07	0.95	2	4
Rule of law	428	2.31	0.27	1.50	2.50
Political risk	428	79.16	5.62	71	91
Corruption	428	6.17	0.23	5.56	6.97
2006 PPP law	428	0.77	0.42	0	1
Macroeconomic variables					
Deficit	428	-6.01	2.51	-9.80	-2.69
Public debt	428	82.21	22.67	48.65	120.00

Table 3. PPP renegotiations

Panel A shows the main data collected on renegotiations events. Panel B exhibits the percentage of PPP that renegotiate under a range of specific conditions. Source: own table, based on data collect.

PANEL A					
Data	Sector				Total
	Roads	Railway	Health	Security	
Number of PPP companies	22	2	10	1	35
Capex (M€)	18,801	502	650	126	20,079
Renegotiations events	233	17	1	3	254
Number of companies renegotiated	22	1	1	1	25
Renegotiations asked during construction stage	78	3	0	2	83
Renegotiations asked operation stage	155	14	1	1	171
Renegotiations with traffic/demand payment	103	17	1	0	121
Renegotiations with availability payment	130	0	0	3	133
Renegotiation asked in electoral years	112	4	1	0	117
Renegotiations accepted	70	12	0	0	82
Renegotiations rejected	5	0	0	0	5
Renegotiations undergoing	158	5	1	3	167
PANEL B					
Indicator	Sector				Total
	Roads	Railway	Health	Security	
Average years between contract and the first renegotiation	3.4	7.0	4.0	2.0	3.5
% PPP renegotiated	100%	50%	10%	100%	71%
% PPP renegotiated in the first 3 years	64%	0%	0%	100%	43%
% PPP renegotiated in the first 4 years	82%	0%	10%	100%	57%
% PPP renegotiated in the construction period	82%	50%	0%	100%	57%
% PPP renegotiated in the operation period	77%	50%	10%	100%	57%
% PPP renegotiations in electoral year	44%	2%	0%	0%	46%
% PPP renegotiations by left government	42%	4%	0%	1%	47%
% PPPrenegotiations with national shareholders	64%	6%	0%	1%	72%

Table 4. Renegotiation motives and timing

Panel A presents the main motives mentioned for each renegotiation event. Panel B gives the average time between the award of the concession and the first renegotiation event, and the time between the beginning of the operations and the first renegotiation event.

We classified these renegotiations motives in three different categories: public sector motives, construction motives and operational and force majeure motives. The reason for this division is the following: the objective was to analyse when renegotiations were started by a government decision and when they were started by a private sector motive. However, data collected was not entirely satisfactory for that purpose. The first classification, public sector motives, grants us motives that could only have been started by the government, and never by the private sector. However, the motives not included in this first classification were still dubious regarding their responsibility. Therefore, we decided to group them according to the PPP stage in which they occurred: construction stage or operational stage (including in this last one the force majeure motives, due to the difficulty in classification and the few number of observations).

Source: own table, based on data collect.

PANEL A					
PPP events	Roads	Railways	Health	Security	Total
Public sector motives					
Specific legal changes	79	0	0	0	79
Corporate tax increase regarding the case-base	11	0	0	0	11
Administrative delays	5	0	0	3	8
Contract changes	6	0	0	0	6
Environmental requirements changes	1	0	0	0	1
sub-total	102	0	0	3	105
Construction motives					
Archaeological findings	35	0	0	0	35
Additional works	23	3	0	0	26
Delay in expropriations	8	0	0	0	8
Construction overruns	7	0	0	0	7
sub-total	73	3	0	0	76
Operational and mjaor cause motives					
Low demand	0	14	0	0	14
Global agreement	11	0	0	0	11
Major cause events	4	0	1	0	5
Additional financial compensation	1	0	0	0	1
Other events	42	0	0	0	42
sub-total	58	14	1	0	73
TOTAL	233	17	1	3	254

PANEL B					
Time between contract and renegotiation	Mean	Median	Minimum	Maximum	Sd. Deviation
Roads	7	7	1	18	4
Railway	9	9	7	11	1
Health	4	4	4	4	0
Security	3	3	2	5	2
TOTAL	7	7	1	18	4
Time between first year operation and renegotiation	Mean	Median	Minimum	Maximum	Sd. Deviation
Roads	6	5	1	15	3
Railway	6	6	6	8	1
Health	3	3	3	3	0
Security	1	1	1	1	0
TOTAL	6	5	1	15	3

Table 5. The probability of PPP renegotiations

This table shows the results of a random effects probit model (due to the Hausman test results) with as dependent variable the renegotiation/no-renegotiation event. Test 1 includes all of the variables defined above, with the exception of the legal and economic variables (Risk rating, Contract viability, Political risk, GDP growth, Deficit and Public debt) which could induce multicollinearity, which is why we include these variables one at the time (Specifications 2-7). Test 8 includes year effects (and therefore drops the political and the economic/legal variables). Panel B presents the marginal fixed effects. Robust standard errors in parentheses. *** stands for p<0.01, ** stands for p<0.05, and * for p<0.1. Source: own table.

Panel A

VARIABLES	(1) Renegotiated	(2) Renegotiated	(3) Renegotiated	(4) Renegotiated	(5) Renegotiated	(6) Renegotiated	(7) Renegotiated	(8) Renegotiated
Sector Variables								
Road sector	5.85***	5.61***	5.53***	5.15***	4.76***	4.93***	5.29***	2.95***
	(1.49)	(1.48)	(1.45)	(1.52)	(1.64)	(1.56)	(1.49)	(0.98)
Railway sector	3.61***	3.48***	3.42***	3.13**	2.69**	2.95**	3.26***	4.76***
	(1.21)	(1.20)	(1.18)	(1.23)	(1.33)	(1.28)	(1.21)	(1.23)
Security sector	3.81***	3.76***	3.69***	3.32***	3.01**	3.21***	3.55***	3.39***
	(1.11)	(1.09)	(1.08)	(1.09)	(1.19)	(1.13)	(1.09)	(0.92)
Concession Variables								
First renegotiation	3.00***	2.86***	2.82***	2.59***	2.73***	2.53***	2.78***	
	(0.60)	(0.59)	(0.59)	(0.57)	(0.60)	(0.56)	(0.58)	
Concession age	-0.06	-0.06	-0.05	-0.02	0.02	0.00	-0.04	-0.05
	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)	(0.04)	(0.04)
Operational stage	0.92***	0.82***	0.83***	0.83***	1.04***	0.94***	0.83***	0.91***
	(0.29)	(0.29)	(0.29)	(0.28)	(0.28)	(0.28)	(0.29)	(0.25)
Availability Payment	-0.36	-0.44	-0.38	-0.02	0.38	0.18	-0.28	-0.28
	(0.31)	(0.33)	(0.32)	(0.30)	(0.28)	(0.28)	(0.32)	(0.29)
Foreign shareholders	-0.09	-0.06	-0.08	-0.16	-0.27	-0.23	-0.08	-0.10
	(0.29)	(0.29)	(0.29)	(0.30)	(0.34)	(0.31)	(0.30)	(0.27)
Ascendi	0.21	0.23	0.19	0.10	-0.02	-0.00	0.15	0.12
	(0.25)	(0.25)	(0.25)	(0.26)	(0.29)	(0.26)	(0.25)	(0.24)
Contract duration	-0.12*	-0.11*	-0.11*	-0.10	-0.07	-0.08	-0.10	-0.07
	(0.06)	(0.06)	(0.06)	(0.07)	(0.07)	(0.07)	(0.06)	(0.05)
Investment	0.18	0.20	0.17	0.11	-0.02	0.02	0.14	0.02
	(0.22)	(0.22)	(0.22)	(0.22)	(0.25)	(0.23)	(0.22)	(0.20)
Number of bidders	0.12**	0.12**	0.12**	0.12*	0.13*	0.12*	0.12*	0.11**
	(0.06)	(0.06)	(0.06)	(0.06)	(0.07)	(0.06)	(0.06)	(0.05)
EIB	0.16	0.14	0.14	0.12	0.06	0.13	0.15	-0.03
	(0.33)	(0.33)	(0.32)	(0.33)	(0.38)	(0.35)	(0.33)	(0.31)
Debt/Capex	-0.02***	-0.02***	-0.02***	-0.02***	-0.02***	-0.02***	-0.02***	-0.02***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)

VARIABLES	(1) Renegotiated	(2) Renegotiated	(3) Renegotiated	(4) Renegotiated	(5) Renegotiated	(6) Renegotiated	(7) Renegotiated	(8) Renegotiated
Political Variables								
Electoral year	0.27	0.27	0.78	-0.25	0.30	-0.72	0.23	
	(0.56)	(0.56)	(0.63)	(0.54)	(0.62)	(0.61)	(0.58)	
Electoral year (t-1)	0.69*	0.73*	0.93**	0.48	0.28	0.38	0.88**	
	(0.40)	(0.39)	(0.42)	(0.38)	(0.40)	(0.39)	(0.42)	
Electoral year (t+1)	0.03	0.03	0.22	0.05	0.43	-0.14	0.03	
	(0.33)	(0.33)	(0.33)	(0.34)	(0.34)	(0.38)	(0.34)	
Right wing government	1.49***	0.01	0.39	0.65**	1.45***	1.02***	0.42	
	(0.34)	(0.32)	(0.29)	(0.27)	(0.38)	(0.30)	(0.29)	
Change in government	0.09	-0.56	-0.74	0.04	-0.65	0.03	-0.16	
	(0.51)	(0.54)	(0.58)	(0.47)	(0.61)	(0.48)	(0.52)	
Majority government	1.35***	0.20	0.54*	0.69**	0.19	0.37	0.40	
	(0.36)	(0.35)	(0.31)	(0.31)	(0.42)	(0.34)	(0.31)	
Legal Variables								
Rule of Law	1.53***	2.05***	2.96***	2.21***	2.71***	2.62***	2.30***	
	(0.50)	(0.49)	(0.53)	(0.47)	(0.53)	(0.53)	(0.50)	
Corruption	-0.74	-1.55**	-0.90	-1.41*	-4.03***	-2.01***	-1.24*	
	(0.74)	(0.63)	(0.76)	(0.73)	(0.89)	(0.71)	(0.71)	
2006 PPP Law	1.91***							
	(0.39)							
Contract viability		-1.03***						
		(0.24)						
Political risk			-0.17***					
			(0.04)					
Risk rating				-0.13**				
				(0.05)				
Economic Variables								
GDP growth					0.35***			
					(0.12)			
Deficit						-0.16*		
						(0.09)		
Public debt							0.03***	
							(0.01)	
Constant	-2.48	5.61	10.10**	11.50***	15.70***	3.53	-2.68	2.67
	(4.74)	(3.96)	(4.33)	(4.26)	(5.36)	(5.04)	(5.09)	(158.27)
Year effects	No	No	No	No	No	No	No	Yes
Wald test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	428	428	428	428	428	428	428	428

Panel B – Marginal effects

Sector Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Road sector	0.911***	0.903***	0.902***	0.889***	0.881***	0.883***	0.893***
	(0.0410)	(0.0429)	(0.0432)	(0.0468)	(0.0495)	(0.0484)	(0.0456)
Railway sector	0.558***	0.554***	0.547***	0.542***	0.511***	0.533***	0.546***
	(0.0731)	(0.0717)	(0.0718)	(0.0737)	(0.0791)	(0.0755)	(0.0723)
Security sector	0.462***	0.462***	0.457***	0.457***	0.437***	0.452***	0.459***
	(0.0483)	(0.0472)	(0.0471)	(0.0473)	(0.0489)	(0.0478)	(0.0470)
Concession Variables							
First renegotiation	0.508***	0.505***	0.499***	0.494***	0.482***	0.488***	0.501***
	(0.0468)	(0.0461)	(0.0459)	(0.0459)	(0.0455)	(0.0461)	(0.0456)
Concession age	-0.0216	-0.0217	-0.0199	-0.00608	0.00767	0.000313	-0.0155
	(0.0142)	(0.0144)	(0.0142)	(0.0136)	(0.0125)	(0.0130)	(0.0140)
Operational stage	0.351***	0.312***	0.319***	0.306***	0.359***	0.338***	0.311***
	(0.0949)	(0.0959)	(0.0956)	(0.0945)	(0.0925)	(0.0924)	(0.0951)
Availability Payment	-0.139	-0.170	-0.147	-0.00155	0.176*	0.0816	-0.103
	(0.119)	(0.125)	(0.124)	(0.117)	(0.0943)	(0.105)	(0.123)
Foreign shareholders	-0.0370	-0.0233	-0.0312	-0.0589	-0.0875	-0.0832	-0.0315
	(0.115)	(0.113)	(0.113)	(0.111)	(0.111)	(0.109)	(0.112)
Ascendi	0.0801	0.0872	0.0740	0.0387	-0.0125	-0.000535	0.0578
	(0.0948)	(0.0944)	(0.0938)	(0.0943)	(0.0919)	(0.0923)	(0.0937)
Contract duration	-0.0465*	-0.0446*	-0.0422*	-0.0399*	-0.0313	-0.0344	-0.0398*
	(0.0240)	(0.0236)	(0.0235)	(0.0235)	(0.0232)	(0.0231)	(0.0233)
Investment	0.0712	0.0792	0.0692	0.0484	0.00738	0.0185	0.0595
	(0.0847)	(0.0840)	(0.0836)	(0.0825)	(0.0809)	(0.0811)	(0.0828)
Number of bidders	0.0476**	0.0473**	0.0471**	0.0454**	0.0475**	0.0457**	0.0470**
	(0.0240)	(0.0238)	(0.0237)	(0.0231)	(0.0228)	(0.0229)	(0.0235)
EIB	0.0645	0.0580	0.0576	0.0564	0.0579	0.0700	0.0656
	(0.128)	(0.126)	(0.126)	(0.124)	(0.125)	(0.124)	(0.125)
Debt/Capex	-0.009	-0.009	-0.008	-0.009	-0.009	-0.009	-0.008
	(0.00266)	(0.00262)	(0.00261)	(0.00257)	(0.00258)	(0.00256)	(0.00259)
Political Variables							
Electoral year	0.106	0.107	0.298	-0.0938	0.111	-0.286	0.0928
	(0.217)	(0.218)	(0.224)	(0.210)	(0.230)	(0.226)	(0.226)
Electoral year (t-1)	0.260*	0.273**	0.339**	0.183	0.106	0.145	0.323**
	(0.139)	(0.135)	(0.136)	(0.140)	(0.151)	(0.145)	(0.137)
Electoral year (t+1)	0.0102	0.0105	0.0867	0.0171	0.163	-0.0644	0.00883
	(0.130)	(0.131)	(0.128)	(0.132)	(0.126)	(0.147)	(0.132)
Right wing government	0.533***	0.00543	0.154	0.250**	0.517***	0.390***	0.165
	(0.100)	(0.127)	(0.111)	(0.100)	(0.110)	(0.0983)	(0.111)
Change in government	0.0354	-0.219	-0.290	0.0147	-0.224	0.0134	-0.0648
	(0.201)	(0.207)	(0.216)	(0.185)	(0.227)	(0.186)	(0.207)
Majority government	-0.446***	0.0766	-0.203*	-0.255**	0.0803	-0.135	-0.152
	(0.0888)	(0.136)	(0.108)	(0.103)	(0.160)	(0.122)	(0.113)
Legal Variables							
Rule of Law	0.603***	0.809***	1.164***	0.870***	1.057***	1.044***	0.905***
	(0.196)	(0.193)	(0.209)	(0.183)	(0.200)	(0.204)	(0.196)
Corruption	-0.289	-0.603**	-0.351	-0.535*	-1.578***	-0.771***	-0.476*
	(0.288)	(0.243)	(0.293)	(0.281)	(0.339)	(0.277)	(0.276)
2006 PPP Law	0.629***						
	(0.0810)						
Contract viability		-0.406***					
		(0.0923)					
Political risk			-0.0676***				
			(0.0157)				
Risk rating				-0.0532***			
				(0.0204)			
Economic Variables					0.136***		
GDP growth					(0.0447)		
						-0.0661*	
Deficit						(0.0338)	
							0.0133***
Public debt							(0.00359)
Observations	428	428	428	428	428	428	428

Table 6. Renegotiation motives

This table shows the results of a multinomial logit model with as dependent variables the renegotiation motives, which are shown in Table 4 (panel A). Motive 1 amalgamates the public sector motives (specific legal changes, corporate tax increases, administrative delays, contract changes, and changes in environmental requirements). Motive 2 stands for the construction motives (archaeological findings, additional investments, delay in expropriations, and construction overruns). Motive 3 captures operational and major cause motives (low demand, major cause events, also called in literature as "Acts of God", global agreement, additional financial compensation and other events). Motive 1 relates to 105 events (41%); Motive 2 to 76 events (30%), and Motive 3 had 73 events (29%). Standard errors are in parentheses; *** stands for p<0.01, ** for p<0.05, and * for p<0.1. Source: own table.

	Test 1			Test 2		
	(a)	(b)	(c)	(a)	(b)	(c)
VARIABLES	Motive 1 versus 2	Motive 1 versus 3	Motive 2 versus 3	Motive 1 versus 2	Motive 1 versus 3	Motive 2 versus 3
Sector Variables						
Railway sector	25.18	-2.34	-27.51	26.76	-2.73	-29.49
	(0.00)	(0.00)	(0.00)	((0.00)	(0.00)	(0.00)
Road sector	9.22	-20.37	-29.59	9.71	-22.11	-31.82
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Security sector	-10.21	-33.69	-23.48	-10.49	-35.93	-25.44
	(0.00)	(0.00)	((0.00)	(0.00)	(0.00)	(0.00)
Concession Variables						
Concession age	-0.44***	-0.13	0.31**	-0.43***	-0.14*	0.29**
	(0.12)	(0.08)	(0.12)	(0.11)	(0.08)	(0.12)
Operational stage	-0.84	0.72	1.56*	-1.18	0.46	1.65*
	(0.73)	(0.75)	(0.84)	(0.77)	(0.77)	(0.86)
Availability payment	-3.39***	-0.62	2.77***	-3.84***	-0.89	2.95***
	(0.96)	(0.86)	(0.97)	(0.97)	(0.84)	(0.97)
Foreign shareholders	1.33	-0.73	-2.06**	1.48	-0.69	-2.17**
	(0.91)	(0.89)	(0.93)	(0.92)	(0.88)	(0.94)
Ascendi	-1.19	-1.82***	-0.63	-0.85	-1.72***	-0.87
	(0.74)	(0.65)	(0.80)	(0.77)	(0.65)	(0.82)
Contract duration	-0.39*	0.10	0.49**	-0.44*	0.11	0.55**
	(0.22)	(0.15)	(0.23)	(0.22)	(0.15)	(0.24)
Investment	0.27	-0.01	-0.27	0.39	0.05	-0.34
	(0.62)	(0.50)	(0.63)	(0.63)	(0.51)	(0.65)
Number of bidders	0.29	0.02	-0.27	0.39	0.06	-0.33
	(0.24)	(0.21)	(0.25)	(0.25)	(0.21)	(0.25)
EIB	1.48*	2.24***	0.76	1.35*	2.23***	0.88
	(0.76)	(0.86)	(0.93)	(0.76)	(0.86)	(0.93)
Debt/Capex	0.00	-0.01	-0.02	0.00	-0.01	-0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)

VARIABLES	Model 1			Model 2		
	Motive 1 versus 2	Motive 1 versus 3	Motive 2 versus 3	Motive 1 versus 2	Motive 1 versus 3	Motive 2 versus 3
Political Variables						
Electoral year	1.55	-1.30	-2.84	-1.11	-2.22	-1.11
	(1.98)	(1.64)	(1.84)	(1.96)	(1.62)	(1.92)
Electoral year (t-1)	0.94	-3.01**	-3.95***	-0.55	-3.44**	-2.89**
	(1.51)	(1.37)	(1.48)	(1.39)	(1.36)	(1.42)
Electoral year (t+1)	0.92	-0.95	-1.87	0.13	-1.39	-1.52
	(1.64)	(1.56)	(1.43)	(1.48)	(1.48)	(1.39)
Right-Wing government	6.36***	2.58	-3.78	6.44**	2.06	-4.38
	(2.32)	(2.19)	(2.75)	(2.79)	(2.60)	(3.50)
Change in government	2.75*	1.49	-1.26	3.60*	1.72	-1.88
	(1.50)	(1.17)	(1.61)	(1.90)	(1.17)	(1.96)
Majority government	-3.95**	-5.36***	-1.40	-2.55	-4.28**	-1.73
	(1.90)	(2.06)	(2.09)	(1.84)	(1.86)	(2.18)
Legal Variables						
Rule of law	-7.17***	-2.49	4.68*	-9.90***	-3.71	6.19**
	(2.40)	(2.21)	(2.62)	(2.79)	(2.40)	(3.01)
Corruption	9.51***	2.88	-6.63**	4.42**	0.68	-3.75*
	(2.95)	(2.35)	(2.88)	(2.23)	(1.71)	(2.24)
2006 PPP Law	9.47***	5.58**	-3.89	9.97***	5.02*	-4.95
	(2.75)	(2.47)	(2.96)	(3.28)	(3.04)	(4.03)
Contract viability	3.63***	1.81	-1.82			
	(1.36)	(1.20)	(1.43)			
Political risk				0.73**	0.28	-0.46
				(0.30)	(0.27)	(0.36)
Constant	-60.10	-0.70	59.40	-69.47	0.95	70.42
	(7,006.51)	(4,408.18)	(5,446.04)	(13,089.86)	(8,235.54)	(10,174.52)
Observations	254	254	254	254	254	254
Pseudo R2	0.387	0.387	0.387	0.390	0.390	0.390

Table 7. Duration models

This table estimates a duration model by means of a Cox-hazard test. The dependent variable is the time between the start of a negotiation and its conclusion (in case of a successful completion) or the end of 2012 (when our data end) (in case of uncompleted renegotiations). Test 1 includes all the variables discussed above with exception of the legal and economic variables (Risk rating, Contract viability, Political risk, GDP growth, Deficit and Public debt) which could induce multicollinearity, which is why they are introduced one at the time. Nine observations were dropped due to a lack of data. Robust standard errors are in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Source: own table.

Panel A – All Sample

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Concession Variables							
Concession age	-0.29***	-0.16*	-0.23***	-0.20**	-0.29***	-0.27***	-0.20**
	(0.07)	(0.08)	(0.08)	(0.09)	(0.08)	(0.08)	(0.08)
Operational stage	0.85*	0.89*	0.59	1.43**	0.84*	0.76	0.62
	(0.50)	(0.50)	(0.51)	(0.61)	(0.51)	(0.52)	(0.50)
Availability payment	-2.00***	-0.25	-1.26	-0.90	-1.98***	-1.79**	-0.95
	(0.69)	(0.88)	(0.80)	(0.87)	(0.69)	(0.75)	(0.82)
Foreign shareholders	-0.29	-0.79	-0.52	-0.63	-0.30	-0.40	-0.65
	(0.65)	(0.69)	(0.67)	(0.68)	(0.65)	(0.67)	(0.68)
Ascendi	0.42	0.11	0.32	0.21	0.42	0.36	0.22
	(0.47)	(0.51)	(0.49)	(0.50)	(0.47)	(0.49)	(0.50)
Contract duration	-0.32***	-0.34***	-0.32***	-0.30***	-0.32***	-0.32***	-0.32***
	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
Investment	1.77***	1.65***	1.71***	1.50***	1.74***	1.71***	1.67***
	(0.50)	(0.55)	(0.52)	(0.53)	(0.51)	(0.51)	(0.53)
Number of bidders	0.26**	0.43***	0.34***	0.32***	0.26**	0.28***	0.37***
	(0.10)	(0.12)	(0.11)	(0.11)	(0.10)	(0.11)	(0.12)
EIB	1.51	2.06*	1.69	1.63	1.50	1.54	1.83*
	(1.05)	(1.05)	(1.04)	(1.02)	(1.05)	(1.04)	(1.05)
Debt/Capex	-0.05***	-0.06***	-0.05***	-0.05***	-0.05***	-0.05***	-0.05***
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Political Variables							
Electoral year	0.97	1.62*	0.75	1.36	1.06	1.29	1.43
	(0.87)	(0.95)	(0.91)	(0.91)	(0.90)	(0.98)	(0.93)
Electoral year (t-1)	0.22	0.68	0.15	0.40	0.24	0.26	0.41
	(0.69)	(0.74)	(0.70)	(0.70)	(0.69)	(0.69)	(0.72)
Electoral year (t+1)	-1.22*	-0.56	-1.15*	-0.96	-1.23*	-1.09	-0.77
	(0.64)	(0.71)	(0.66)	(0.66)	(0.64)	(0.68)	(0.70)
Right wing government	-1.35**	-0.60	-1.10*	-1.32*	-1.29*	-1.47**	-1.26**
	(0.66)	(0.66)	(0.66)	(0.69)	(0.70)	(0.69)	(0.64)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Change in government	-0.59	0.10	-0.19	-0.28	-0.66	-0.51	-0.30
	(0.82)	(0.84)	(0.84)	(0.86)	(0.85)	(0.84)	(0.82)
Majority government	-0.51*	-1.20*	-0.43	-0.27	-0.42	-0.71	-0.47
	(0.69)	(0.69)	(0.68)	(0.67)	(0.74)	(0.74)	(0.67)
Legal Variables							
Rule of law	-1.13	-0.86	-1.60*	-1.18	-1.06	-1.42	-1.13
	(0.78)	(0.75)	(0.82)	(0.79)	(0.82)	(0.88)	(0.75)
Corruption	1.42*	1.58*	-0.67	-0.60	-1.28	-1.27	-0.92
	(1.00)	(0.88)	(1.08)	(1.02)	(1.08)	(1.00)	(0.95)
Contract viability		1.50***					
		(0.51)					
Political risk			0.12*				
			(0.07)				
Risk rating				0.20*			
				(0.10)			
Economic variables							
GDP growth					0.06		
					(0.18)		
Deficit						0.10	
						(0.14)	
Public debt							-0.04**
							(0.02)
Observations	245	245	245	245	245	245	245
Pseudo R2	0.277	0.290	0.282	0.283	0.278	0.278	0.284

Panel B – Road Sector

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Concession Variables							
Concession age	-0.20**	-0.04	-0.12	-0.04	-0.21***	-0.17*	-0.09
	(0.08)	(0.09)	(0.09)	(0.09)	(0.08)	(0.09)	(0.09)
Operational stage	0.60	0.80	0.38	1.60**	0.64	0.47	0.38
	(0.56)	(0.55)	(0.55)	(0.69)	(0.56)	(0.58)	(0.55)
Availability payment	-2.60***	1.11	-1.44	-1.07	-2.74***	-2.19**	-0.76
	(0.90)	(1.64)	(1.09)	(1.00)	(0.95)	(1.03)	(1.20)
Foreign shareholders	0.45	0.24	0.34	0.07	0.52	0.32	0.21
	(0.98)	(0.88)	(0.96)	(0.89)	(0.99)	(0.98)	(0.93)
Ascendi	1.57**	1.51**	1.58**	1.63**	1.61**	1.50**	1.49**
	(0.70)	(0.69)	(0.70)	(0.70)	(0.70)	(0.70)	(0.69)
Contract duration	-0.55***	-0.44***	-0.49***	-0.43***	-0.56***	-0.52***	-0.47***
	(0.15)	(0.14)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
Investment	1.70***	0.95*	1.43***	0.68	1.78***	1.59***	1.26**
	(0.52)	(0.56)	(0.54)	(0.59)	(0.55)	(0.54)	(0.55)
Number of bidders	-0.11	-0.20	-0.13	-0.27	-0.11	-0.11	-0.15
	(0.20)	(0.20)	(0.20)	(0.22)	(0.20)	(0.20)	(0.20)
EIB	1.12	0.87	0.86	0.19	1.22	0.97	0.80
	(1.45)	(1.41)	(1.42)	(1.59)	(1.46)	(1.46)	(1.42)
Debt/Capex	-0.06**	-0.04*	-0.05*	-0.04	-0.06**	-0.05**	-0.05*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Political Variables							
Electoral year	0.20	0.31	-0.42	0.87	0.00	0.44	0.19
	(0.90)	(0.93)	(0.98)	(0.97)	(0.97)	(0.96)	(0.91)
Electoral year (t-1)	-1.09	-1.05	-1.50*	-0.78	-1.18	-1.15	-1.32*
	(0.72)	(0.74)	(0.77)	(0.73)	(0.75)	(0.73)	(0.74)
Electoral year (t+1)	-2.76***	-2.54***	-3.02***	-2.45***	-2.82***	-2.72***	-2.69***
	(0.79)	(0.80)	(0.81)	(0.79)	(0.80)	(0.79)	(0.80)
Right wing government	-0.19	0.59	0.04	-0.12	-0.31	-0.30	-0.21
	(0.66)	(0.68)	(0.67)	(0.70)	(0.69)	(0.68)	(0.67)
Change in government	-0.43	0.27	-0.11	-0.08	-0.28	-0.42	-0.22
	(0.76)	(0.79)	(0.77)	(0.78)	(0.81)	(0.76)	(0.76)
Majority government	0.20	-0.86	0.12	0.38	0.06	-0.11	0.09
	(0.84)	(0.87)	(0.84)	(0.83)	(0.88)	(0.93)	(0.85)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Legal Variables							
Rule of Law	-0.95	-0.60	-1.47	-0.97	-1.08	-1.26	-0.98
	(0.89)	(0.88)	(0.94)	(0.87)	(0.93)	(0.97)	(0.87)
Corruption	2.06**	2.22**	1.05	1.16	2.25**	1.85*	1.29
	(1.03)	(0.94)	(1.18)	(1.04)	(1.11)	(1.05)	(1.02)
Contract viability		2.44***					
		(0.87)					
Political risk			0.14*				
			(0.08)				
Risk rating				0.33***			
				(0.12)			
Economic Variables							
GDP growth					-0.11		
					(0.20)		
Deficit						0.12	
						(0.15)	
Public debt							-0.05**
							(0.02)
Observations	224	224	224	224	224	224	224
Pseudo R2	0.327	0.351	0.334	0.341	0.328	0.328	0.339

Figure 1 - PPP Investments (1995–2011) as percentage of GDP

This figure shows the relative weight of PPP investments according to the size of each economy (level of accumulated PPP investment, over the period 1995 to 2011, as a percentage of GDP). Source: figure based on data collected from EIB (for investment in PPPs) and Ameco (for GDP).

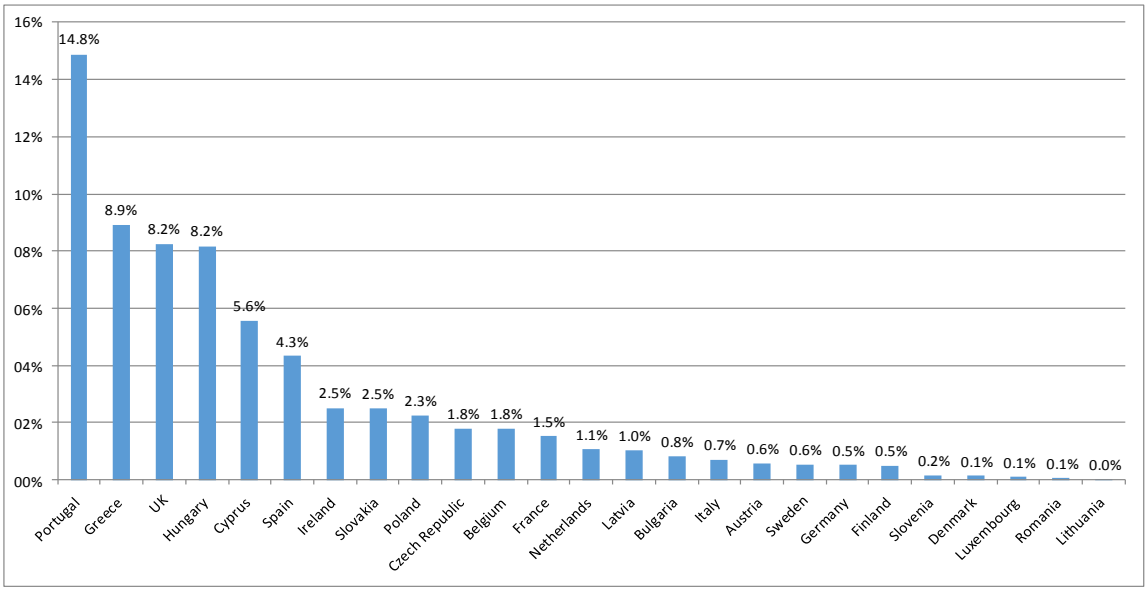

Figure 2 – PPP renegotiations by year

This figure shows the number of renegotiations in Portugal by year. Source: own data.

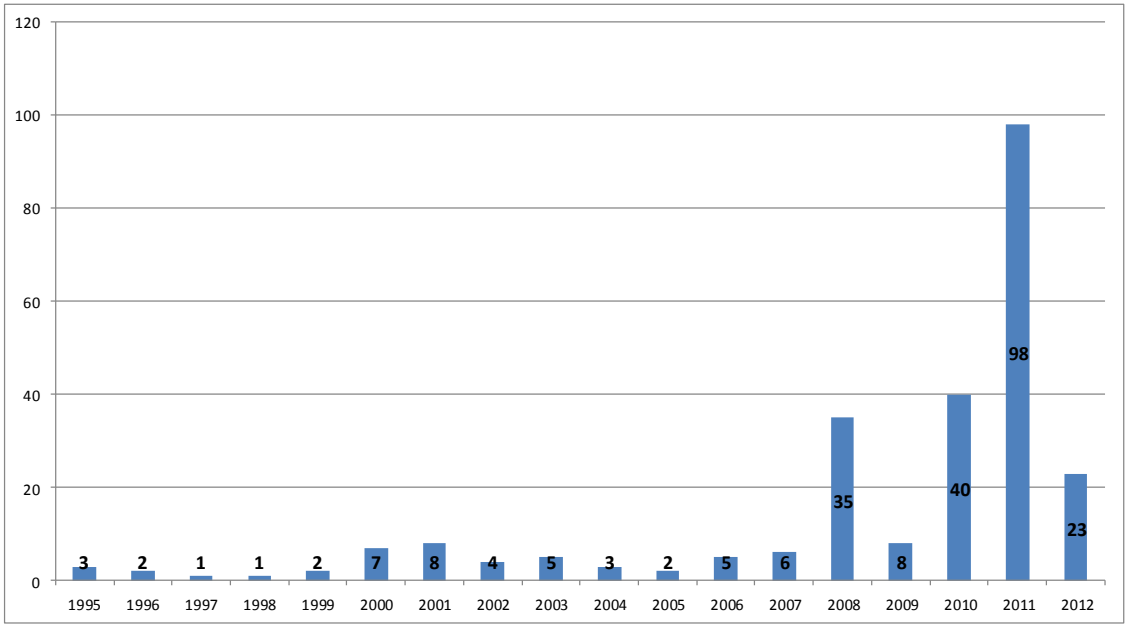

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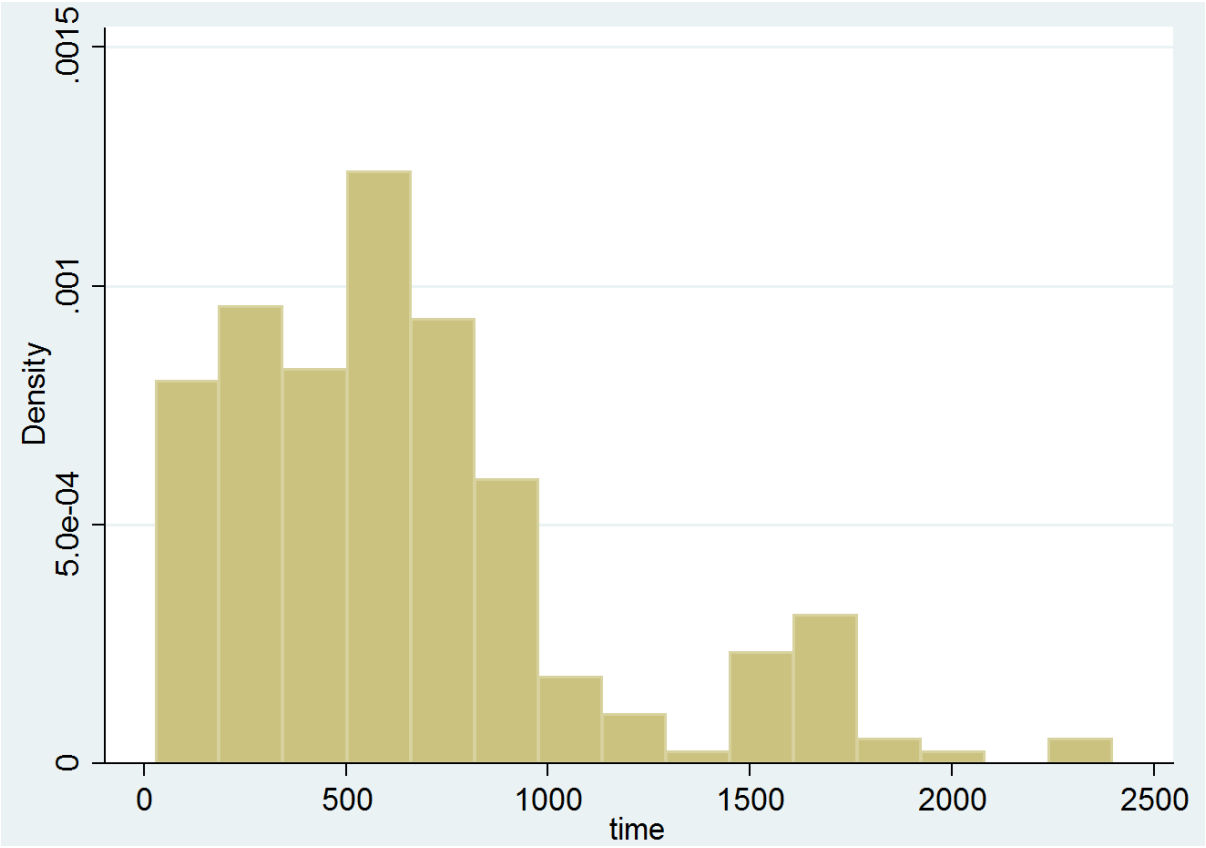
Figure 3 – Histogram of the duration of renegotiations



Source: own data.

Chapter 4

Efficiency of Highway Public-Private Partnerships

ABSTRACT

As there is growing concern regarding the efficiency of public resources spent in public-private partnerships (PPPs), we measure the efficiency of seven PPP highway projects in Portugal over the past decade by means of a Data Envelopment Analysis model and the Malmquist productivity and efficiency index. This study analyses the relative efficiency changes, in the sense that shows whether a specific highway has improved its efficiency during a certain period. Therefore, the concept of PPP efficiency should not be confound with the argument of Value for Money (VfM) as there is no comparison in this study with the public sector efficiency.

We distinguish between technical and technological efficiency, and find that most highways face a reduction over time in both types of efficiency, mainly due to an increase in operating and maintenance costs, follow-up investments, and a decline in traffic. A second group only experienced a reduction in technological efficiency following a loss of traffic which was compensated by cost control and stable investments. While controlling for scale efficiencies (which are anyhow very limited), a lack of pure technical efficiency is found for highway PPPs that were not subject to a competitive environment, which produces a lack of incentives for better management. Not only is there evidence of poor management due to a lack of competitive pressure, but increased use of outsourcing also increases inefficiencies. The introduction of tolls and the outburst of the economic crises in Portugal have substantially reduced traffic further contributing to inefficiency. Finally, the local context, such as highways in low-income areas and rural regions with a lower traffic density affect PPP highway performance.

KEY WORDS: Public-Private Partnerships, procurement, efficiency models, transport, highways.

JEL codes: D24; H54; L91;

1. Introduction

Governments around the world have increasingly used Public-Private Partnerships (PPPs) to build and manage large public infrastructure projects. However, this was gradually followed by concerns regarding the efficient use of public money in PPPs relative to public procurement, and by doubts about whether PPPs really represent value for money (VfM) for the public sector. The efficiency in highway PPPs does not just boil down to a directly measurable VfM concept,

but has a larger impact on the regional economic development in terms of trade and mobility. Although most of the PPP projects around the world were created to improve the infrastructure, and mainly to construct highways, only few studies have examined their efficiency. The debate about what drives highway PPP efficiency has predominantly concentrated on the need for economies of scale in terms of the ideal highway dimension, whereby Amdal, Bårdsen, Johansen, & Welde (2007) and Odeck (2008) argue that highway size increases efficiency, whilst Welde & Odeck (2011) reach the opposite conclusion. The Portuguese experience with a large number of PPP-highways provides fertile testing ground to explore the factors that can affect efficiency, such as the financial and non-financial inputs and outputs, shareholder composition, level of investment, and urban/rural or coastal/interior geography.

We use a Data Envelopment Analysis (DEA) with a Malmquist index to test the efficiency of seven PPP highway projects. The advantage of using a non-parametric method such as DEA is that one does not a priori need a functional form on technology or any restrictive assumption regarding input remuneration (Barros, Felício, & Fernandes, 2012). DEA and the Malmquist index has been applied to measure the efficiency of units in a certain year or the change of efficiency over a period of years for a large field of organisations and activities (Vitner, Rozenes, & Spraggett, 2006), such as hospitals or schools (Dharmapala, 2009; Alexander, Haug, & Jaforullah, 2010; Barnum, Walton, Shields, & Schumock, 2011;), seaports (Barros, 2003; Al-eraqi, 2008; Panayides, Maxoulis, Wang, & Ng, 2009; Barros et al., 2012;), airports (Gillen & Lall, 1997; Fernandes & Pacheco, 2002; Yoshida & Fujimoto, 2004; Barros & Dieke, 2007), and public transport (Husain, Abdullah, & Kuman, 2000; Pina & Torres, 2001; von Hirschhausen & Cullmann, 2010).

Portugal has been developing its highway sector over the last 20 years, building substantial stretches of highways. The first wave of PPPs in the highway sector comprised the so-called SCUTs highways where SCUT stands for “Sem Custos para o Utilizador”, which is Portuguese for “without cost to the user”. The first wave of highway contracting (between 1999 and 2001) consisted of seven separate contracts and is the focus of this paper. The motivations to carry out this analysis are: First, there is very little research on the efficiency of PPPs in general (and none on Portuguese PPP highway efficiency). Second, we apply an efficiency methodology not yet applied to highway research, which also includes financial and non-financial data of both inputs (operating and maintenance costs, investment and number of employees) and outputs (revenues and daily traffic). Third, this study about the efficiency of highway operations is timely because the highway regulator is in the process of renegotiating these PPPs. The need to reduce future public payments – in the context of the chain of recent global financial crises which has hit Portugal hard - puts pressure to cut operational and maintenance expenses and encourages the search for greater efficiency.

This paper is organized as follows. Section 2 provides a brief review of the literature on PPPs and the efficiency of highways. Section 3 presents the institutional framework for Portuguese highway PPPs. Section 4 describes our data and gives a brief account of the methodology used. We present the results in section 5, and the conclusions, limitations and suggestions for future study in section 6.

2. Literature review

2.1 PPPs and their efficiency

Traditionally, two main reasons are usually brought forward to make the case that the public sector ought to be responsible for large transport infrastructure projects. The first is known in literature as "market failure", the fact that most projects are not profitable or at least require high levels of investments that only makes them profitable in the long run (Borzel & Risse, 2005). Consequently, these projects tend to not attract the interest of the private sector investment. However, for social and political reasons, this infrastructure must be provided to society. The second main reason regards the positive externalities that a transport infrastructure brings to the economy (Grimsey & Lewis, 2004). Better infrastructure brings about indirect benefits that are usually not considered in the cost-benefit analysis of the project. For instance, the construction of a new road could reduce travel time and accidents, bringing benefits to people and companies, even though they have not paid for it.

Over the last few decades, the public sector's role in infrastructure has changed substantially, especially since the introduction of a new concept: PPPs. This is an alternative to the traditional public procurement where the public sector is responsible for all stages of the project (planning, design, construction, financing, operations and maintenance, plus the residual value). In the case of PPPs, some of these functions become the responsibility of the private sector. This does not mean that the public sector no longer pays for the assets, but signifies that the private sector becomes responsible for the construction, financing, and maintenance of the asset. Grimsey & Lewis (2002) define a PPP as *"an agreement whereby the public sector enters into long-term contractual agreements with private sector entities for the construction or management of public sector infrastructure facilities by the private sector entity, or for the provision of services (using infrastructure facilities) by the private sector entity for the community on behalf of a public sector entity*". This agreement implies a process of risk allocation.

The risks that occur in a PPP context can be categorised in several ways: (i) endogenous versus exogenous risks (the latter risks cannot be controlled for); (ii) commercial risks (preferably allocated to the private sector) versus legal and political risks (usually allocated to the public sector) (OECD, 2008); (iii) risks related to the development (planning and construction), operation and transfer phases, and the lifetime phase (political, finance, environmental, and force majeure risks) (Jin, 2010); and (iv) risks at the macro, meso, and micro level (Bing, Akintoye, Edwards, & Hardcastle, 2005). Macro-level risks are exogenous and can be narrowed down to country/industry risks and acts of God or force majeure. Meso-level risks are endogenous risks that occur within the boundaries of the project system and are thus related to construction, demand, and technological risks. Micro-level risks are stakeholders' risks and are party-related (rather than project-related). Although different parties typically have different perceptions of what is a proper risk allocation, the optimal risk allocation reduces economic costs, provides incentives for sound management, and reduces the need for future renegotiations (Abednego & Ogunlana, 2006; Asenova & Beck, 2010). In PPPs, most risks can be allocated in a simple way: risks can be retained by the public sector, transferred to the private company that manages the PPP (which could in turn opt to reallocate risks to third parties), or shared between public and private parties (Sarmento & Renneboog, 2014b).

The purpose of a PPP for the public sector should be to create value for money (VfM), and it should not be motivated by the fact that it can be (has been) treated as an off-balance sheet investment (Grimsey & Lewis, 2005). VfM is not about cost effectiveness alone, whereby the same quantity and quality of services should be provided at a lower overall cost (the whole-of-life cost to meet the users' requirements) (Ball, Heafey & King, 2007), but also about value delivered through risk transfer, innovation, greater asset utilisation, and integrated whole-of-life management (Fitzgerald, 2004). According to Debande (2002) and Quiggin (2005), the benefits of PPPs should compensate the additional costs incurred by the need to resort to private sector financing. The private sector tends to be considered as more efficient than the public sector because the former is subject to better incentives to make more cost-effective investments, to control operational costs, and especially to better manage risks. Daube, Vollrath, & Alfen, (2008) add that PPPs are characterised by optimal risk allocation and a holistic life-cycle approach, which is very important for long-life investments, such as transport infrastructure.

Taking the above considerations into account, studies on PPPs' efficiency are relevant and their insights could lead to substantial cost savings for the public sector in case they identify remediable flaws in the contracting, investment, and operational processes.

2.2 DEA, highways and efficiency

The aim of DEA is to calculate an efficiency frontier measured as the relative performance of different Decision Making Units (DMUs) in terms of distance per unit to the ideal frontier constructed using observed input and output data (Brebbia, 2014). Bogetoft & Otto (2010), asserted that the highway, when considered as a business, contains all the general characteristics of the production systems in which DEA models are widely used. Applying the efficiency analysis theory by means of a DEA analysis, researchers can build a model to evaluate alternative schemes and to analyse and diagnose ineffective schemes. In addition, Cooper, Seiford, & Zhu (2011), stresses the fact that it has become imperative for highway sector organisations to rationalise their operating costs and to improve the quality of services offered. The author obtains measures of purely technical, scale, and overall efficiency for both public and private agencies and establishes that DEA can be used for the evaluation of the relative efficiency of multiple homogeneous decision-making units. It should also be noted that the advantage of using the DEA framework is that it is capable of handling noneconomic factors, such as the number of accidents, maintenance cost per day, traffic per day, and the average age of the pavement, and it also allows for the measurement of such factors on different scales. Bhagavath (2006), argues that the DEA model is particularly suited for determining the efficiency of highways, as factors such as traffic intensity and safety parameters are an essential part of highway transport.

The objectives of highway efficiency models are to meet the largest possible traffic demands with the lowest traffic delays with minimal inputs: the minimum number of highway lanes that requires the lowest level of investment along with the lowest level of operational costs during the life-cycle of the project (Ozbek, de la Garza, & Triantis, 2010). DEA model analysis shows that the most beneficial improvements to operational highway efficiency can be achieved by reducing the resource consumption levels of individual vehicles, the amount of funds available, the time and space resources of the highway, and the price of environmental pollution, among other resources (Mao, 2010). According to Odeck (2008), the objective of DEA is to compare the performance of different urban networks to provide technical support to policy makers for the choice of actions that need to be implemented to make a highway system efficient. Brebbia (2014) states that DEA analysis enables highway agencies to calculate a value of the relative efficiency of each highway network, on the basis of which networks are ranked, thus distinguishing efficient networks from inefficient ones.

2.3 DEA studies on highway efficiency

The few studies that have been conducted in this field of research are summarised in Table 1. Academic research has been focused on two particular issues: measuring inefficiencies and the impact of dimensions (economies of scale). Several studies have concluded that highways were operating at an inefficient level (Deller & Halstead, 1994; Odeck, 2008; Welde & Odeck, 2011). Different causes for this inefficiency are brought forward: maintenance costs that are higher than necessary, poor management skills, and a lack of competition.

The debate has also concentrated on the impact of highway dimensions and on whether economies of scale are determinants of highway efficiency. Studies by Amdal et al., (2007) and Odeck (2008) conclude that the highway's dimension is a critical factor of its efficiency and that operating costs are reduced with increased traffic: operating costs vary significantly but larger companies that serve more traffic have lower levels of operating costs per vehicle. This result suggests important and unexploited economies of scale. For Odeck (2008), larger companies (measured by the number of lanes or by the number of km) tend to be more efficient because highways with a longer dimension are able to reduce the unitary fixed costs. These conclusions are supported in the case of the Italian highway concessionaries, as Benfratello, Iozzi, & Valbonesi (2008) found economies of density and scale using an L-shaped average cost curve over the range of output. In contrast, Welde & Odeck (2011) propound the notion that economies of scale are not always significant in terms of highway efficiency because they are able to present evidence of companies with low traffic levels having efficiency scores of 1.0 (the maximum efficiency in DEA model) or thereabouts.

[Insert Table 1here]

To conclude, efficiency measurement and benchmarking in highway transport is an important topic, whether one is interested in comparing the efficiency of different highway networks or in learning how to improve their efficiency. It is also relevant to define negotiation parameters for future PPP projects. The calculation of relative efficiency scores by means of the DEA model generates insights into the performance of highways of various dimensions and localizations, which thus guides the choice of the required actions. The benefit of using the DEA model in this context is that it is free from a priori assumptions on functional forms and is applicable to units, such as highways, that have several outputs (e.g. traffic and revenues). Still, the weakness of the DEA model is that it is sensitive to outliers and can generate multiple best-performers. DEA can be combined with other approaches to separate and measure the technological advances that can be used to improve highway efficiency over time. Specific studies on DEA highways have

identified sufficient potential to increase their efficiency. However, there is no consensus about the main determinants of that increase and the impact of economies of scale. The debate is expected to continue at least until a sufficient number of projects are studied in detail over their entire life-cycle.

3. The Portuguese Highway Sector Experience and SCUTS Projects

Since 1993, when the first PPP was created to build the "Vasco da Gama" bridge, Portugal has launched a total of 35 PPPs, mainly within the periods 1999 to 2002 and 2008 to 2010 (Sarmento & Renneboog, 2014b). The majority of these projects were in the highway sector (22 projects), but some were also in the health (10), railways (2) and security (1) sectors. Seventeen billion Euros were invested by the private sector over these last two decades. Highways absorbed the largest part of the investment (80%), with railways, health, and security attracting 18%, 2%, and 1%, respectively. The significant number of projects and the size of the investments represent a large liability for the public sector in terms of future payments that will become due over the coming decades. Between 2014 and 2020, annual payments will stand for 1% of the GDP. From 2020 to 2035, annual payments will gradually be reduced to nearly 0.5% of GDP. If we use a discount rate of 6% which is used by the Portuguese government for public sector investments, we can calculate that the NPV of the future payments (from 2014 beyond) reaches 10% of the 2014 GDP. Despite the importance of PPPs in Portugal, only few studies have been conducted (de Lemos, Eaton, Betts, & de Almeida, 2004; Monteiro, 2005; Sarmento, 2010; Basílio, 2011; Cruz & Marques, 2011; Sarmento & Reis, 2012; Sarmento & Renneboog, 2014b).

In the highway sector, two waves of PPPs have emerged. The first one comprised seven SCUT highways, which are the subject of this study. Since its inception, there have been debate and controversy as to whether PPPs were the best option for contracting the construction of highways and whether PPPs have delivered value for money for the public sector. The SCUTs extend over a total of 930 kilometres and were originally equipped with shadow tolls which imply that the payment to the private sector was at the expense of the public budget in lieu of the users.

Currently, after several rounds of renegotiations, the SCUTs no longer operate with shadow tolls but with real electronic tolls to users. The individual concessionaries charge the tolls, but these revenues are transferred entirely to the government. In exchange, the concessionaries receive a fee for maintaining the operation of their concessions. According to the Court of

Audits, these renegotiations have reduced the level of risk of the private sector, while revenues were maintained or in some cases even increased.[1]

4. Methodology and data

4.1 Methodology

In order to assess the efficiency of the Portuguese PPP highways, we have used a DEA by estimating a productivity Malmquist Index. The Malmquist Index measures the productivity changes over a period of several years, and is decomposed into changes in efficiency and technology. DEA measures the efficiency of each decision making unit within a group relative to the (observed) more efficient unit within that group (Charnes, Cooper, & Rhodes, 1978; Bhagavath, 2006). The more efficient DMU is the one that lies on the efficient frontier and assumes a value of one in the model. All the other DMU´s are compared with the more efficient unit, and have a value between zero and one. A DEA model can be subdivided into an input-oriented model, which minimizes inputs while satisfying at least the given output levels, and an output-oriented model, which maximizes outputs without requiring more of any observed input values (Cook, Tone, & Zhu, 2014). Hence, efficiency is measured in terms of a proportional change in inputs or outputs.

In line with Cooper et al. (2011), we find two types of efficiency in a DEA model: technical and allocative efficiency. The first type of efficiency signifies that for the current technological level, there is no waste of inputs for a certain level of output. This is the type of efficiency that is directly affected by management or scale; an organization operating at best-practice is said to be 100% technically efficient (Bhagavath, 2006). The allocative efficiency refers to the use of resources so as to maximise profit and utility, more specifically, by minimizing of costs for a unit already technically efficient. This is, the inputs should be used in such a way to reach technical efficiency (i.e. minimum inputs and maximum outputs), but also to minimize costs.

How does the DEA work? DEA is a non-parametric approach, meaning that the efficiency frontier does not assume any particular functional form, which may be considered an advantage. However, it does not provide a general relationship, in terms of equation, for relating inputs and outputs (Charnes, Cooper & Rhodes, 1978). It identifies an efficiency frontier on which the relative performance of all the DMUs in the sample can be compared against the best DMU. If

[1] The audit report is available in http://www.tcontas.pt/pt/actos/rel_auditoria/2012/2s/audit-dgtc-rel015-2012-2s.pdf

firms only used one input to produce one output, then the efficiency score would easily be calculated by dividing the value of the input by the value of the output. However, in case of multiple inputs and outputs, DEA assumes a linear programming methodology that enables presenting a single value of efficiency when the production process presents a structure of multiple inputs and outputs. DEA makes for each unit a combined weight, with an optimal estimation of inputs and outputs. It is necessary to refer to how this optimal estimation is made: The weights for the inputs and outputs do not have to be identified because they are determined and optimised by the DEA model. The weights used are DMU specific, and during the application of DEA, they are optimised by each DMU to maximise its efficiency rating.

This way, each unit can still be represented in a simple chart, with a single input and output value, and an efficiency frontier can be drawn. The units in the frontier will have a value of 1. A DMU is said to be efficient if the ratio of its weighted outputs to its weighted inputs is larger than the similar ratio for every other DMU in the sample. All the other units, the DEA measures the distance of the unit to the frontier, assuming a value between 0 and 1.

Therefore, we can draw some of the DEA characteristics: There is no assumption regarding the Input-Output Function, and it does not require a weight restriction. More often, there is no limit to the number of inputs and outputs. Finally, it is an important tool for benchmark and decision making.

In our DEA analysis, we use the Malmquist index to evaluate the productivity change of each unit between two periods of time (Cooper, Seiford, & Tone, 2007). This index divides technical efficiency change into pure and scale efficiency changes (Malmquist, 1953; Caves, Christensen, & Diewert, 1982). Whereas pure technical efficiency represents the technical efficiency devoid of scale effects, meaning that the efficiency stands entirely under the control of the management (it is also called managerial inefficiency), the latter type of efficiency is a direct consequence of dimension. A unit is scale efficient when its size of operations is optimal: if its size is either reduced or increased, its efficiency will drop (Färe, Grosskopf, & Brännlund, 1996; Barros & Dieke, 2008). Scale efficiency will have a maximum value of 1, assumed by the DMU with the most productive scale size. Also, the technological progress with respect to outputs is Hicks-neutral if the marginal rate of transformation between two outputs is constant, holding the mix of outputs constant (Barros et al., 2012). The Malmquist index measures the efficiency of DMUs by means of multiple inputs and outputs over a certain period of time, and represents the total factor productivity growth of a DMU, reflecting the progress (or regress) in the efficiency and the frontier technology of that unit over a period of time (Cooper et al., 2011).

The Malmquist index decomposes the change in total factor productivity into a change in technical efficiency and technological change, whereby the former is equal to a change in pure

technical efficiency multiplied by a change in scale efficiency change. Pure technical efficiency is the impact of management on the company efficiency (also called managerial efficiency). Consequently, this part of a company's increase or decrease in efficiency can be ascribed to the managers and their decisions regarding the level of inputs and outputs and the efficient utilisation of resources. This process may be considered input orientated, meaning how much the inputs can be reduced while maintaining the same level of outputs, or output-orientated, and representing how much the outputs can increase by maintaining the same level of inputs. Certain decisions, such as changing the operational process, improve quality or reduce costs can lead to better pure technical efficiency.

Scale efficiency regards the (dis)economies of scale of a certain unit. It could either represent economies of scale (i.e., an increasing return to scale (IRS)), due to being at less than optimum size, or diseconomies of scale (i.e., decreasing returns to scale (DRS)), due to being at more than the optimum size (Isik & Hassan, 2003). A reduction in scale efficiency represents the cost of operating at an incorrect scale. It is necessary, however, to consider that an increased or reduced scale is always influenced by the market. Moreover, in the specific cases of highways, there is a clear limitation on the size and scope of the operation, as dimension is a project variable defined and most difficultly changed during the concession period. However, large highways, with more kilometres and lanes should be more efficient due to this scale effect. As economies of scale refer to a situation in which if production is increased by some amount, costs increase by a lesser amount. Thus, companies serving a greater number of lanes and, implicitly, a larger amount of traffic, should be more efficient than others are (Odeck, 2008).

Technological efficiency is the impact on the increase or decrease of the overall firm efficiency caused by use of the technology by itself. This means to produce new technology that may reduce costs or increase revenues. In the case of highways, several examples can be given: electronic payment systems, replacing staff with toll-collecting machines or better maintenance materials and systems.

The total factor productivity frontier is de facto a best-practice frontier and that DEA is also referred to as 'balanced benchmarking' (Sherman & Zhu, 2012). If a change in the distance to the efficiency frontier relative to the previous year is higher (lower) than 1, then a reduction (increase) in efficiency has occurred. A detailed explanation on how the inputs and outputs relate to the Malmquist index is discussed in Färe, Grosskopf, Norris, & Zhang (1994), Isik & Hassan (2003), and Barros et al. (2012).

The linear program software (we used DEAP) takes a three step approach: first, for each combination of inputs and outputs, an efficiency frontier is generated consisting of the most efficient units (using a constant return of scale whereby an increase in inputs results in a

proportionate increase in the output levels). Secondly, the Malmquist index measures the difference of each unit to the efficiency frontier over time: for instance, as our sample starts in 2003, the efficient frontier is calculated for 2003 and 2004 and the first value of the Malmquist index for 2004 is the difference in deviations to the efficient frontier of a unit for 2004 and 2003. The distance function to the efficiency frontier is calculated as follows:

$$MI^{t+1} = \frac{E^{t+1}(x^{t+1}; y^{t+1})}{E^{t}(x^{t}; y^{t})} (1),$$

where MI stands for the Malmquist index and x and y are inputs and outputs, respectively. Finally, once the Malmquist index is calculated for each year, we take the geometric mean of the values for each firm. Suppose we have 4 units using one input and one output for period t and t+1, and that the units have the following combinations of inputs/outputs: A(0,5;0,5), B(2;2); C(1;2), D(2;1) at t and A1(1;1); B1(2;3), C1(1;3), D(3;1,5) at t+1. From Figure 1, we observe that C is the most efficient unit and that B had no efficiency gains between t and t+1 because its distance to the efficiency frontier has remained equal. (It should be noted that in a single input and output case, the efficiency frontier reduces to a straight line).

[Insert figure 1 here]

4.2 Data

We use a balanced data panel, comprising all seven Portuguese companies involved in the first PPP highway wave (the free highways, with concessionaries' tolls originally paid for by the government) during the period 2003 to 2012. The annual data were obtained from the concessionaries' Annual Reports and from the Portuguese highway regulator (InIR – Portuguese for Institute of Road Infrastructure) that also has supervisory responsibilities. The proportional rule required by DEA is that the number of observations should be more than three times the sum of inputs (in our case, we use operating and maintenance costs (O&M), total assets, and number of full time equivalents (ftes)) and outputs (in our case, revenues and daily average traffic/km or DAT/km): 63 (7 PPPs * (10-1) years) is larger than 3 x (2+3) (Cooper et al., 2011). All of the units (companies) utilise the same type of inputs to produce some types of outputs and we have a balanced dataset.

A summary of variables defining each highway project is presented in Table 2: the distance, capital expenditure (Capex) by km, location (inland or coast), type of district (urban or rural), and type of shareholder (domestic versus foreign). The Capex by km defines the level of investment and is expected to have a strong impact on efficiency. The main cost for highways is occurred at construction stage, as the yearly operation and maintenance costs represent around

1% of the total investment (Sarmento, 2010). Location is relevant, as the Portuguese inland is mountainous, faces cold weather (which affects the maintenance costs), and is much less populated than the coastal regions. Moreover, a highway in an urban area is expected to attract more traffic by km, but then again the maintenance costs will be higher (as highway maintenance is usually performed without entirely closing the road, more dense traffic makes the work more complex).

Our data vary across PPPs: for instance, the Capex/km varied from 1.69 M € (for the A22, a coastal urban operation in the south of the country) to 6.46 M € (for the GP, a similar operation – coastal and urban – but it circles around the second largest city in Portugal). The distances range from 72 km (the GP) to almost 180 km (the A23, 178 km and the A25, 176 km, both are inland rural highways). The average highway stretches for 133 km, and its Capex/km is €3.4m. Other performance-related information (revenues, operating and maintenance costs, daily average traffic /km) is presented in Table 3.

[Insert tables 2, 3 and 4 here]

The descriptive statistics of the two outputs and three inputs are reported in Table 4. In line with the efficiency literature, we use as outputs: DAT/km (daily average traffic, which is the total traffic of a highway in a year divided by the number of days, and subsequently, divided by the number of kilometres) and revenues (i.e. the payment for concessionaries according to PPP agreements signed with the Portuguese authorities). The inputs required for handling traffic volume and managing all of the operations combine financial and non-financial data: O&M (operating and maintenance) costs, which include salaries; total assets (i.e., the investments by year); and the number of employees (ftes) (Table 4). It should be noted that a reduction in the number of employees does not necessarily lead to an increase in efficiency, but may simply represent a transfer of service to outsourcing companies, which affects the O&M costs. Outsourcing is standard practice with PPPs which are this way able to reallocate the operational risk to a third party. However, we show that this reduction of risk was not followed by an increase in efficiency.

5. Empirical Results

The Malmquist index does not identify the causes of efficiency, in the sense that the result only shows an increase or decrease in efficiency, but it enables us to identify the inefficient units, either in terms of change in technical efficiency or technological change. With that information, it is possible to compare the evolution of either inputs or outputs and how they affect the

changes of efficiency. Furthermore, by grouping the different units according to the increase or decrease in the different types of (in)efficiencies, we can assess the possible explanations regarding the units' characteristics. We consider the following characteristics: (i) the change in the inputs and outputs in each company during this period; (ii) the scale of each highway or its length (in kms), as we expect scale efficiency to have a positive impact on overall efficiency; (iii) the investment level as expressed by the Capex/km as a high level of investment is expected to reduce highway efficiency; (iv) the location (inland or coastal) because the Portuguese inland is mountainous which can reduce efficiency; (v) the type of district, as urban areas attract higher traffic density which should increase efficiency; and (vi) the main shareholders: a PPP with national shareholders may be more efficient (from a private partner's perspective), because, due to political connections, they may have been able to attract more favorable contract conditions. The average Malmquist indices for each of the toll-free highways are presented in Table 5.

[Insert table 5 here]

Table 5 (column 1) shows that the total factor productivity change score (which equals the Malmquist index) amounts to 1.2096 which is above one and hence signifies that there was a deterioration (of -0.2096) in highway productivity during this period. The only exception to the overall deterioration is highway A27. The average change in technical efficiency (column (2)) amounts to 1.008, which indicates that pure and scale efficiency slightly decreased (the A17 and A25 are mainly responsible for the reduction). The average change in the technology (column (3)) amounts to 1.2 and also demonstrates that there was degradation in the technological efficiency, which signifies that investments were scarce over the past decade.

Finally, we observe that the change in pure technical efficiency and the change in the scale efficiency are limited. The former small decline may still be due to the limitations of competition in this sector. The latter indicates that there is no apparent effect of dimension in highways (only A17 and A25 have values slightly different from one where one signifies no change in the efficiency).

When we break down the Malmquist index into an efficiency change and a technological change, we are able to identify three groups of highways. The first category consists of the most inefficient PPP toll-free highways in terms of productivity: their productivity decline is due to the simultaneous deterioration of technological change and technical efficiency, or put differently, the Malmquist index >1, technical efficiency change >1 and technological change >1. Highways A17 an A25 belong to this category and both underwent a substantial increase in the O&M costs and a decrease in the number of employees because the two companies outsourced more of the maintenance and operations. Given that these two highways belong to the same national group, Ascendi, they could be subject to a negative scale efficiency effect, a

conclusion reinforced by the fact that the two highways are geographically connected. Also, the value of the assets of these two highway companies increases significantly for both (in terms of additional investments), which were not compensated by higher revenues with a resulting decrease in efficiency. Both highways also suffered from a strong reduction in traffic following the introduction of tolls in 2010. The second group of highways is characterized by a productivity decline caused by deterioration in technological change (Malmquist index >1 with technical efficiency change =1 and technological change >1) and includes the A22, A23, A24 and GP. The decline in productivity is related to a substantial loss in traffic (almost 50%), but they were able to keep follow-up investments down and to maintain O&M costs at a stable level. The third group of highways with a productivity improvement resulting from technological improvement (Malmquist index <1, technical efficiency change =1 and technological change <1) only comprises one highway: the A27. Both the O&M costs and the number of employees in this company remained stable, investment was low and, in spite of tolls, traffic did not decline over the sample period.

We also find that for some highways O&M costs increase, followed by a significant reduction in the number of employees which implies that the highway PPPs resorted to more outsourcing. Furthermore, substantial levels of follow-up investment decreased it efficiency, but it is most likely that over the coming years, as the investment requirements decline, these highways will augment their efficiency. It is worth noting that the introduction of tolls (in 2010) along with the economic crises has led to a substantial reduction of traffic in almost all highways, and hence efficiency.

When we rank the seven highways in terms of the efficiency scores (with the most efficient coming first) we get: A27, A23, GP, A22, A24, A17, and A25. This shows that there seem to be no scale effects. In terms of location, highways in coastal areas perform better than the ones in mountainous regions, as the traffic volume is higher in the former increasing the use of these assets. Also, highways mainly situated in rural areas perform better than those located in urban ones, which is related to the fact that O&M costs are higher in urban areas because the maintenance of highways in urban areas is more complex and costly. The major cause of productivity degradation in (initially) toll-free Portuguese highways is efficiency deterioration.

6. Discussion and Conclusions

We have estimated the Malmquist input-based index of total factor productivity for seven Portuguese highways over the period 2003 to 2012. A linear programming analysis has resulted in an efficiency frontier – the best-practice benchmark – against which the efficiency of each

highway can be gauged. We have first dissected the productivity change into a change in technical efficiency and technological change. This analysis has revealed that the average productivity slipped for Portuguese SCUT highways. In general, this change is predominantly caused by a drop in technological efficiency and to a lesser extent to a reduction in technical efficiency. Although the Malmquist index does not identify the causes of each of type of (in)efficiency, the identification of poor and strong performers still enables the parties involved in the PPP to delve deeper to the sources of (in)efficiencies. Efficiency change is mainly associated with managerial practices and technological efficiency is related to new (follow-up) investments and procedures. We have found for most highways that there is some evidence of weak management in terms of O&M costs, possibly due to a low competitive pressure. Also, some highways were still, particularly during the first years, making large investments, which decreased their efficiency. The substantial reduction in traffic as a consequence of the recent financial crises and the introduction of levying electronic tolls has had a negative impact on traffic density and resulted in the fact that the infrastructure is not used at maximum efficiency. It is also important to note that the efficiency performance of each highway is mainly driven by its local context, particularly location and district. Some remote highways are inefficient on account of being located in low-income districts with scarce traffic. Other companies suffered from a lack of investment or qualified human resources caused by cost-control policies induced by the financial crises.

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Table 1 – Literature review on highway efficiency studies

This table presents the main studies regarding efficiency and performance of highways. Source: own table

Paper	Method	Units	Inputs	Outputs	Conclusions
Deller (1994)	Stochastic frontier model	Rural highways	Labour wages Price of motorised grader Price of dump trucks	Miles of highways	Maintenance costs higher than necessary due to managerial inefficiencies
Erik Amdal (2007)	Panel data analysis	26 toll highways	Traffic Lanes Debt OBU – cars' on-board units	Average cost per vehicle	Very important unexploited economies of scale Higher share of vehicles using on-board units significantly reduces average costs Competitive tendering reduces average costs Increase number of lanes, debt and passenger charging increases average costs
Odeck (2008)	DEA	18 companies, from 2001 to 2004	Operational costs Payments to managers	Annual traffic Number of lanes	Potential for efficiency increases Economies of scales: Larger companies are more efficient than smaller ones Productivity increase due to companies using more efficient methods to collect revenue
Ozbek (2010)	DEA	Highway maintenance	19 cost maintenance inputs, such as climate, cost, traffic, accidents or speed limit	7 outputs, such as changes in highway or bridge conditions and pollution	Theoretical background and framework Specific inputs and outputs for bridges
Welde and Odeck (2011)	DEA and stochastic frontier analysis	20 companies from 2003 to 2008	Operational costs Administrative costs	Annual traffic Number of lanes	Great potential for efficiency improvement No evidence of economies of scale, unlike (Odeck, 2008) (however, data were different)

Table 2: Characteristics of Portuguese PPP highways

This table presents the main data on the PPPs used in this study. Besides the dimension of each highway (measured in km), we also observed the investment by km (Capex/km), the geographical location (I for highways mainly situated in the interior and C for those mainly located in the coastal area). We also present the type of district (U if the highways are in urban areas and R if they are in rural ones). We also record if the main shareholders are domestic (the majority of the capital is owned by Portuguese groups) or foreign. Source: Own table, based on information from INIR (Institute of Road Infrastructure).

SCUT Name	Highway Name	Km	Capex/Km (million €)	Localisation	Urban Rural	Main Shareholders
A23	SCUT Beira Interior	178	3,31	I	R	Domestic
A24	SCUT Interior Norte	155	3,18	I	R	Foreign
A22	SCUT Algarve	129	1,69	C	U	Foreign
A17	SCUT Costa de Prata	105	2,79	C	U	Domestic
GP	SCUT Grande Porto (GP)	72	6,46	C	U	Domestic
A25	SCUT Beiras litoral e alta	176	3,94	I	R	Domestic
A27	SCUT do Norte Litoral	115	2,65	C	R	Foreign

Table 3: Operational characteristics of Portuguese PPP highways

This table presents the main characteristics of the highways used in this study for the year 2012. DAT/Km real traffic stands for the daily average traffic by km observed during the year. O&M costs stands for means operating and maintenance costs (these costs include salaries). Source: Own table, based on information from INIR (Institute of Road Infrastructure) and Concessionaries' Annual Reports.

SCUT Name	Revenues (000 €)	DAT/KM real traffic	O&M Costs (000 €)
A23	121,243	9,400	25,442
A24	90,253	6,685	8,514
A22	38,592	8,219	4,734
A17	43,280	19,988	17,015
GP	78,506	22,151	11,605
A25	97,147	9,172	18,912
A27	48,133	20,305	6,951
Mean	73,879	13,703	13,310
Median	78,506	9,400	11,605
St. dev	31,408	6,743	7,441

Table 4: Descriptive Statistics of Input and Output Data

This table presents the descriptive statistics of the inputs and outputs used in the Malmquist index for the period 2003-2012. DAT stands for daily average traffic and O&M for operating and maintenance costs. Source: own calculations.

Variable	Description	Min.	Max.	Mean	Median	Standard Deviation
	Outputs					
Revenues	In 000 Euro at constant prices; 2005=100	2,683	149,222	52,646	41,740	43,147
DAT/KM real traffic	Daily average traffic by Km (real traffic)	4,257	38,073	18,492	17.202	10,715
	Inputs					
O&M Costs	In 000 Euro at constant prices 2005=100	3,236	24,943	7,356	5,610	4,525
Total assets	000 Euros at constant prices; 2005=100	97,009	1,302,098	582,780	507,411	269,229
Number ftes (Employees)	Number	2	109	33	19	29

Table 5. Efficiency decomposition for Portuguese PPP highways

This table presents the Malmquist index for the seven highways examined in this study over the period 2003-2012. The index is decomposed in technical efficiency change and technological change. The change in technical efficiency is also dissected into a change in pure technical efficiency and a change in scale efficiency. Source: own calculations.

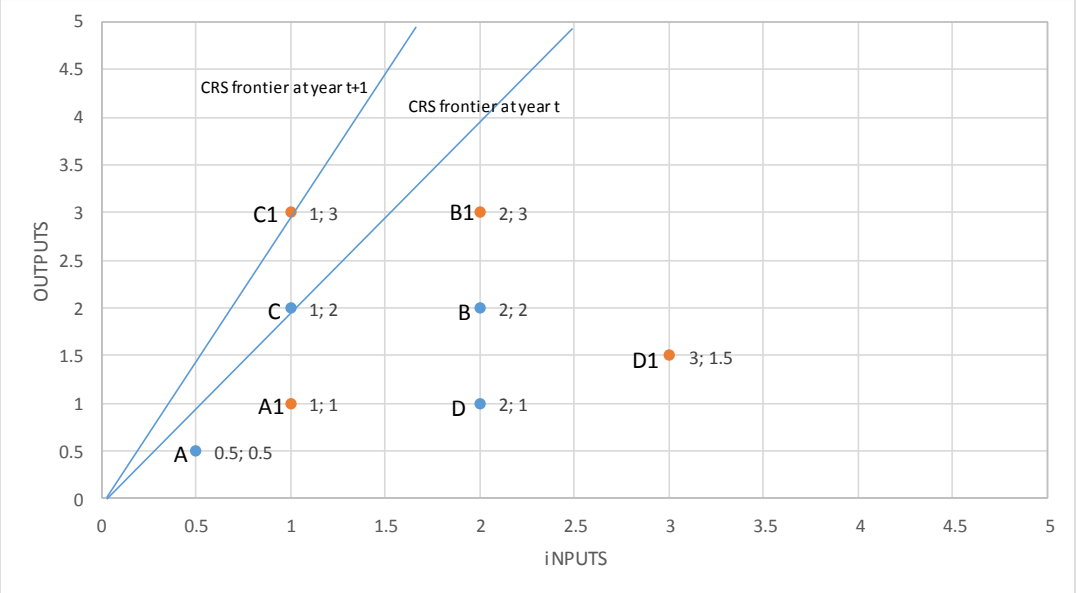
	(1)	(2)	(3)	(4)	(5)
Highway	Malmquist index	Δ Technical Efficiency	Δ Technological Efficiency	ΔPure technical efficiency	Δ Scale efficiency
A23	1.161	1.000	1.161	1.000	1.000
A24	1.248	1.000	1.248	1.000	1.000
A22	1.247	1.000	1.247	1.000	1.000
A17	1.339	1.034	1.295	1.007	1.026
GP	1.233	1.000	1.233	1.000	1.000
A25	1.359	1.021	1.331	1.000	1.021
A27	0.934	1.000	0.934	1.000	1.000
Mean	1.210	1.008	1.200	1.001	1.007
Median	1.247	1.000	1.247	1.000	1.000
Std. Dev	0.1311	0.0129	0.1217	0.0024	0.0107

Figure 1 – The Malmquist index using a Constant Return of Scale DEA model

This figure presents an example of how the Malmquist index is represented by means of the DEA distance function. A, B, C and D represent the input/output efficiency of 4 firms in year t and A1,B1,C1,D1 in year t+1. The Malmquist index calculates the change in the distance of each unit to the efficiency frontier, regarding period t and t+1. If the unit moves closer to the efficiency frontier, then this represents an increase in efficiency. For each company, we calculate the ratio between the two distance measures at t and t+1.

Considering this example, what is the function of the DEAP software? The first step, for each year, is to calculate the DEA score for each unit. As mentioned before, the DEA generates a combined weight for each unit, with an optimal estimation of inputs and outputs. The second step is that the Malmquist measures the distance of each unit to the efficiency frontier in each year and then compares it with the previous year. This provides a year value for the efficiency change for t1 compared with t. Therefore, the Malmquist will have tn-1 observations for each unit. The third step is that for each unit, the Malmquist provides a final value of the efficiency change by calculating the geometric mean of the year values calculated in the second step.

Source: own calculations.



Chapter 5

Cost Overruns in Public Sector Investment Projects

ABSTRACT

The high level of public resources allocated to infrastructure expenditures, along with concerns regarding the efficiency and value of these projects, has created increasing concern regarding cost deviation. Using a sample of 243 projects from 1999 to 2012, we analyse cost overruns in public infrastructural investment projects in Portugal. The average cost deviation amounts to 24%. Large projects, which are often more complex, have a longer duration, are subject to higher risk, have a higher cost deviation and a higher probability of cost overruns, which suggests that the public administration may not be well prepared to handle these types of projects. Local and regional governments seem to control costs better than the central government. There is no evidence that right or left wing governments are better or worse at adhering to the budget. Still, cost overruns are more likely in election years, as politicians seem eager to conclude infrastructural investments, and thus, they inaugurate a new service to harvest political goodwill with the population. Over time, while cost deviations are reduced, this reduction does not appear to be the result of the new procurement law but rather is most likely the result of other factors, such as more experience or increased fiscal constraints. Less corruption reduces not only the level of deviations but also the probability of cost overruns.

KEYWORDS: public sector, public works, cost deviations, Portugal

JEL: H40; H82

1. Introduction

It is a well-known fact that most infrastructure is built by the public sector. There are several reasons why governments spend taxpayers' money on building roads, railways, prisons, hospitals, schools, and museums, among other types of public assets. The first reason is market failure, as the private sector is normally not interested in this type of investment because it may take too long to recuperate the heavy initial investments. Second, this type of infrastructure is usually regarded as a public good. Third, providing infrastructure to the community generates positive economic and political externalities.

The large amount of public resources that the public sector spends on infrastructure generates concerns about the effectiveness of these projects. One of the main sources of concern is cost deviation. When finished, a project can experience three situations with respect to the final cost:

a positive deviation (i.e., the project cost is greater than the initial forecast), no deviation or a negative deviation (i.e., the cost is less than the forecast). There are two main reasons why cost overruns are a source of concern. That is, either they represent a source of inefficiency in the use of public resources and/or they represent a cost underestimation of the initial project. Whereas the academic literature focuses on positive cost deviations (see, for instance, Flyvbjerg, Holm, & Buhl (2002), or Cantarelli, Flyvbjerg, van Wee, & Molin (2008)), also called cost overruns or cost escalation, this study will focus on the above three types of cost deviations.

Despite their relevance, quantitative studies based on a large sample of projects covering different sectors and countries are rare. For instance, Flyvbjerg et al. (2002), being an exception, focuses on the amplitude of cost deviations and the main determinants of those deviations. In the existing literature, we found evidence of cost deviations between 10% and 30% of the initial cost, with most of the projects showing cost overruns. The main causes for cost deviations in public projects are optimism as decision makers tend to assume optimist bias in cost forecast and opportunistic behaviours as public managers tend to underestimate costs to have their projects approved. Additional causes of cost deviations include the size of the project, the region/country were the project is developed and the period of implementation. This research serves as a strong contribution to extant literature for two reasons. Specifically, most of the data herein are not publicly available, and we were able to collect a large sample of infrastructural investments.

In this paper, we use a sample of 243 public investment projects in Portugal over the period 1999 to 2012. We concentrate on assessing their cost deviations and the probability of cost overruns.

There are several hypotheses in this study (as we will also see in the data section): i) There is a cost overrun pattern in public projects ii) Central government is more efficient than regional and local governments; iii) Large projects increase cost overruns; iv) election years (or their nearby) increase cost overruns; v) the new procurement law introduced in 2008 has reduced the incidence of cost overruns; vi) A better legal and regulatory environment reduced the cost overruns, as well as a low corruption level.

We reach eight main conclusions. First, cost overruns appear to be the standard in public investment projects. Second, projects initiated by the central government have larger cost overruns. Third, there is a clear scale effect as measured by large projects that increases the deviations and the probability of cost overruns. Fourth, while no political party in government is more efficient in avoiding cost overruns, we find evidence that election years increase the likelihood of cost deviations and cost overruns in a project because the government is willing to

pay more to have the infrastructure ready before elections. Fifth, the 2008 change in the procurement law has failed to produce a better procurement system. Sixth, while the better rule of law reduces cost deviations, it has no impact on the probability of cost overruns. Seventh, cost overruns increase with corruption. Eighth, experience, better governance, and control reduce cost deviations.

This paper is organised as follows. Section 2 presents a literature review. The methodology and data are presented in section 3. Section 4 presents the results, and Section 5 presents the conclusions.

2. Literature Review

2.1 The role of the public sector in infrastructural investments

The construction and maintenance of infrastructure - public infrastructural investments - is mainly a public sector responsibility (Savas, 2000). As such, they are characterised by a long duration in construction and operation, as well as by capital intensity, and a complex valuation process (Grimsey & Lewis, 2002).

There are several reasons why the government spends taxpayer resources on infrastructure such as roads, railways, ports, airports, schools, hospitals, theatres, museums, etc. One reason is that a market failure emerges when the allocation of goods and services is not efficiently arranged by market forces (Bator, 1958). Such failure is observed in scenarios where individuals' pursuit of self-interests leads to results that are not efficient, i.e., they can be improved upon, from a societal perspective, leading to government intervention (Stiglitz, 1989; Arrow, 1996). In the particular case of infrastructure, governments intervene because the development of infrastructure requires a long-term view and faces a high level of risk. Therefore, the private sector is not eager to deliver these types of goods and services as there is uncertainty about their long-run profitability. However, for social and/or political reasons, as the infrastructure must be made available to society, it becomes the public sector's responsibility. As such, infrastructure becomes a public good as the benefits are shared across the community in such a way that those who do not wish to buy the service cannot be excluded from the benefits created by those who do (Grimsey & Lewis, 2004).

Furthermore, infrastructural investments produce positive externalities that affect society as a whole. This occurs when the actions of firms or consumers impose costs or confer benefits on third parties, which the firms or the consumers fail to take into account when choosing their

actions (Brealey, Cooper, & Habib, 1997). For instance, the construction of new road may reduce travel time and accidents.

Despite the increase of private sector participation in building and maintaining infrastructure (through public private partnerships, concessions, or privatisations), the need - with respect to decision making, planning, and the allocating of resources - for the public sector to develop the infrastructure remains.

The various financial crises over the past 15 years have made the constraints to public resources more binding and the topic of cost overruns in infrastructural investments more relevant. Accordingly, it is surprising that there is little research on this subject as noted by the literature reviews of Siemiatycki (2009), and De Jong, Annema, & Van Wee (2013), who found less than twenty studies with (some) statistical analyses.

2.2 Public investments and cost deviations

The main reason for the limited academic research is the lack of data. Most studies treat an individual case (or a small number of cases), which raises questions about the generalizability of the conclusions. Other research papers concentrate on changes in legal or regulatory frameworks (e.g., Nijkamp & Ubbels (1999), or van Marrewijk, Clegg, Pitsis, & Veenswijk (2008)). The most relevant literature with some degree of statistical analysis is listed in Table 1, and focuses on two issues: the level of cost deviations (or cost overruns) and the main determinants of cost deviations (or cost overruns).

[Insert Table 1 here]

The most comprehensive quantitative study is by (B. Flyvbjerg et al., 2002). The study presented a panel of 254 projects with data on investments in roads, railways and bridges in the US, Europe, and Japan for sample period 1910 to 1998. The study reports an average cost overrun of 28% across all sectors and of 45%, 34%, and 20% for rail, bridges, and roads, respectively). Blanc-Brude, Goldsmith, & Valila (2006, 2009), find an average cost overrun of 24% for road projects in Europe from 1990 to 2008.

Bent Flyvbjerg & Stewart (2012), also investigated infrastructural investments related to the Olympic Games between 1960 and 2012 and documented an average cost overrun of 179%. For other types of large investment projects, such as electrical infrastructure and large dams, Sovacool, Nugent, & Gilbert (2014), and Ansar, Flyvbjerg, Budzier, & Lunn (2014) found average cost overruns of 66% and 96%, respectively.

Most studies focus on data from only one country, such as Odeck (2004, 2014), and Magnussen & Olsson (2006), focus on Norway, Cantarelli et al. (2008), on the Netherlands, Makovšek, Tominc, & Logožar (2011), on Slovenia, and Lundberg, Jenpanitsub, & Pyddoke (2011), on Sweden.

Although there are no studies that revisit analyses of specific sectors by country, Table 1 may reveal some patterns. The older studies show higher levels of cost overruns in the range of [50% to 100%], e.g., P. Morris & Hough (1991) and S. Morris (1990) in India and MacDonald (2002), in the UK. In contrast, more recent studies show cost deviations less than 20%, e.g., Odeck (2004, 2014), and Magnussen & Olsson (2006), in Norway, Lundberg et al. (2011), in Sweden, Aibinu & Pasco (2008) and Creedy, Skitmore, & Wong (2010) in Australia, Cantarelli et al. (2008) in the Netherlands, Makovšek et al. (2011) in Slovenia and Bucciol, Chillemi, & Palazzi (2013) in Italy.

2.3 The main determinants of cost deviations

The main determinants of the cost deviations reported in the literature are (i) imprecise project concept design planning, risk management and implementation, and poorly organised bidding processes; (ii) over optimism in the forecasts; (iii) time effects (as the passage of time yields better experience, thus reducing cost overruns); (iv) country/region where projects are located; (v) size of the investments; and (vi) public versus private ownership of the project and inefficiencies at the level of the central and regional/local governments.

In many ex post cost analyses, technical difficulties in forecasting the costs of infrastructural investments lead to cost escalations (see, e.g., Flyvbjerg (2004)). In addition, subsequent changes in project scope, design, delays, financial constraints, and technological innovations during the development and construction stages explain some of the overruns (Nijkamp & Ubbels, 1999; Lee, 2008). There is a strong statistical relationship between the length of implementation and the increase in cost escalation (Flyvbjerg, 2004). An obvious reason is that cost estimates are usually prepared using limited past data as guidance), limited valuation and forecasting skills of public servants, and imperfect forecasting models (Aibinu & Pasco, 2008; Odeck, 2014). For instance, the introduction of new quality standards with respect to project planning, implementation and control has contributed to a reduction in cost deviations in Norway (Magnussen & Olsson, 2006).

Some studies argue that technical failures in the planning and construction phases do not provide an accurate explanation for cost deviations because if cost deviations were explained by technical failures, the distribution of those deviations should follow a normal distribution near

zero, which is not the case. Furthermore, improvement over time should be expected as experience from planners and managers increases, which is also not the case. Therefore, Siemiatycki (2009), and Altshuler & Luberoff (2003), claim that over-optimism biases and political decisions are more plausible as explanations for cost overruns.

Political decisions influence cost deviations by what Flyvbjerg (2002), called strategic misrepresentation. This refers to the deliberate underestimating of the cost to have a lower budget for the project. With limited resources, the project may not be selected if the decision makers were aware of the real cost of the project. Furthermore, competition between projects creates political and organisational pressures to emphasise future benefits and pare down the costs and risks. Once a project is started, it is not likely that a project will be cancelled or its scale reduced because most projects are committed to by politicians and interest groups, making it difficult to reverse decisions at a later stage (Priemus, 2007). Instead, it is more likely that projects receive additional funding to compensate for the positive cost deviation. The result is that non-viable projects continue to be implemented, leading to an inefficient allocation of resources.

The optimism bias in forecasting costs refers to the public sector accepting a lower probability of a negative event occurring, although this systematic bias may also be found among appraisers who under-/over-estimate a project's key parameters. Most of this bias is natural, as Lovallo & Kahneman (2003) note that most people are highly optimistic most of the time, and accordingly, managers also make decisions based on this optimism. Wachs (1990), further contends that if politicians favour one project over another, the forecasters may tacitly select assumptions that are more favourable to the project supported by the politicians. Most studies did not find evidence to support the notion that experience in public projects leads to more accuracy in new investment projects (see, e.g., Aibinu & Pasco (2008)).

Flyvbjerg et al. (2002), found statistical evidence that some regions, such as Europe and the US, perform better in terms of matching public investment costs with the budget than do others. It could be that less developed countries have poorer procurement systems, financing, control and governance, and accountability with respect to the management of public investments (Kaming, Olomolaiye, Holt, & Harris, 1997; Lee, 2008; Kaliba, Muya, & Mumba, 2009).

One aspect on which the literature is less unanimous is the impact of the project dimension. It is not clear whether cost deviations as a percentage of the budget costs occur more frequently in small or large projects. Some authors argue that larger projects should have a higher percentage of cost deviations (e.g., Merewitz (1973); Morris & Hough (1987)) because larger projects are more complex and such complexity may be positively related with cost deviations (Flyvbjerg et al., 2002). While these authors found evidence of this relationship in bridge and tunnel projects,

they did not find such evidence in road or railway projects. An explanation could be that roads and railways possess a divisibility characteristic that bridges and tunnels do not. That is, roads can be divided into several phases, for instance, a 200 km highway can be divided into several stages), while this is not the case for bridges and tunnels.

Although there is some evidence that cost deviations are related to the size of the investment projects, cost overruns are mainly due to the project's complexity (e.g., tunnels, geographical terrain) and most evidence finds a higher percentage cost deviation for small projects (Odeck, 2004; Aibinu & Pasco, 2008). As large projects have a more substantial fiscal impact, decision makers and the public could be more sensitive to budget overruns for large projects. Moreover, small projects may have fewer resources in terms of staff for planning and control, which makes these projects less reliable with respect to forecasts.

Finally, the literature has also focused on the nature of ownership of the project. Despite the public decision making and funding, the private sector has assumed over the past few decades a major role in building and operating infrastructure. This increased importance of the private sector has taken many forms, such as public-private partnerships, concessions, or privatisation. Governments seek private sector participation with two main goals: finding new sources of financing, particularly in periods of strong fiscal constraints, and utilising the private sector's expertise and higher efficiency in construction, operations, and risk management (Grimsey & Lewis, 2005). Delivering infrastructure through privatisation or other private sector arrangements may create more market discipline, with incentives to be more efficient while reducing the probability of errors in forecasting. Therefore, infrastructure built and operated by the private sector is expected to have lower cost overruns than that managed entirely by the public sector. Although Blanc-Brude et al. (2006); Blanc-Brude, Goldsmith, & Valila (2009b) found that PPP highways in Europe were built at lower costs than those under traditional procurement, there is little evidence that could be generalised indicating that the private sector has been more efficient in avoiding cost overruns than has the public sector (Handler, 1996; Flyvbjerg et al., 2002; Shaoul, Stafford, & Stapleton, 2006).

3. Methodology and Data

3.1 Data

The dimension of the cost deviations and the probability of cost overruns can be affected by (i) the project's characteristics, (ii) political constraints, and (iii) the institutional and legal environments. Table 2 summarises the independent variables as well as their expected signs.

[Insert Table 2 here]

Education, transports, social facilities, and economic facilities identify the sector of the project. *Education* captures whether the project is in the education sector, mainly the construction of a new school. *Transports* relates to roads, bridges, railways, ports and airports. *Social facilities* represent projects in the health, social housing, or cultural sectors, while *economic facilities* include projects related to economic infrastructures, such as rural markets or industrial parks.

Subsector is an indicator variable taking the value of 0 if the project is developed by the central government and 1 if it is developed by regional or local governments. Traditionally, regional and local Portuguese governments have been associated with less accountability and more overspending than the central government. This does not mean, however, that the central government functions efficiently.

Parque Escolar is a dummy variable capturing whether the project is developed under the Parque Escolar programme, a major infrastructure programme developed between 2009 and 2012. This program was the Portuguese response to the financial and economic crisis that began in 2008. Despite the political controversy - mainly regarding the type of projects and the total volume of investment and debt - cost deviations are low. Hence, we expect this variable to be negatively related with cost deviations.

Large project is a dummy variable capturing whether the project is a large project. This is defined in the Portuguese legislation, according to the size, relevance, and complexity of the project. For instance, in our sample, we have as large projects the stadiums for 2004, the new bridge under Coimbra and the music house of Porto. These projects are under special control and scrutiny, but due to their higher complexity and the pressure to open within the expected time, we expect this variable to be positively related with cost deviations.

Election year lag and *election year* refer, respectively, to whether the year of the project conclusion was the year prior to an election or the election year itself. Politicians often expect to harvest political benefits from public sector investments. In addition, underestimating costs may be a strategy that helps to get projects approved. Therefore, we expect these variables to be positively related to cost overruns.

Right-wing party is a dummy variable for the party in government, assuming 0 if the party in government is the socialist party (left wing) and 1 if it is the social democrat party (liberal, right wing).

2008 procurement law is 0 if the project was concluded before the introduction of the new regulatory framework regarding public procurement laws and 1 if it was concluded subsequent to the law. We expect that this new legal framework, which is mainly the result of European Union directives, has strengthened the procurement process, thereby reducing cost deviations. Thus, this variable is expected to have a negative signal. In order to assess results in this

variable, we will introduce, for control variables, three economic variables: GDP growth, inflation and public deficit. The source for these three variable is the Portuguese national statistics office.

Rule of law is a proxy for the quality of contract (enforcement). This variable is dynamic, with the values ranging from 0 to 100. The best possible score is 100 whereby an increase in the score represents an improvement in the country's situation regarding this indicator. Better enforcement should reduce cost deviations. Rule of law represents the quality and strength of the legal system and shows the judicial limits of government to realise its policy program through the legislative arm of government. *Corruption* is a dynamic variable representing the level of corruption in a country, which ranges from 0 to 10, with 10 being the lowest possible level of corruption. If a private contractor believes that the government is subject to influence, the odds for cost overruns as a way to capture additional rents increases.

The descriptive statistics of these variables are summarised in Table 3.

[Insert Table 3 here]

We have performed several data diagnostic tests. The correlation matrix (not reported) shows no evidence of strong correlations between variable pairs (nor did the VIF tests). Therefore, multicollinearity is not likely to lead to estimation problems. We also performed a Breusch–Pagan test for heteroscedasticity and rejected the null hypothesis. In addition, the Wald test was statistically significant, which implies that the regressors have an important collective impact on renegotiations.

3.2 Methodology

We collect data for 243 projects that were developed between 1999 and 2012 from two sources: the Portuguese Court of Audits and the Ministry of Finance Internal Audit (IGF). The Court of Audits is an independent body similar to the national audit office in other countries, such as the UK or Australia, and is the supreme body that examines the legality of public expenditures. As such, this body audits the accounts that the law has ordered to be submitted to the Court.

From these reports, we collect the following information for each project: (i) the year of conclusion; (ii) the initial budget cost; (iii) the final cost; (iv) the project's sector; and (v) whether the project was developed by the central, regional, or local (municipal) government. To assess the cost deviation of each project, we calculate the percentage of the deviation as [(final cost – initial budget cost)/initial budget cost]. We also study what determines the (percentage of) cost deviation in our sample projects by means of this model:

$$Yi = \beta_0 + \beta_1 education + \beta_2 transports + \beta_3 social\ facilities + \beta_4 subs + \beta_5 parque\ escolar + \beta_6 large\ project + \beta_7 election\ year\ lag + \beta_8\ election\ year + \beta_9\ right\ wing\ government + \beta_{10}\ 2008\ procurement\ law + \beta_{11} GDP\ growth + \beta_{12}\ Inflation + \beta_{13}\ public\ deficit + \beta_{14}\ rule\ of\ law + \beta_{15}\ corruption + \mu i$$

We test this model by means of an OLS with and without year effects as a number of crucial variables are not time dependent. We also estimate GLM and a Tobit models with left censoring whereby we only consider projects with positive cost deviation (cost overruns). Finally, as some cost overruns are exceptionally high (above 100%, which is more than three times the average deviation), we also run a Tobit model with left and right censoring after eliminating extreme cost overruns.

To measure the probability of a cost overrun, we run a logit model whereby cost overruns take the value 1 (and negative or no cost deviations take the value 0). Of the sample projects, 155 have cost overruns and 91 have no deviations or have negative cost deviations.

4 Results

4.1 The descriptives of cost deviations

The average cost deviation is approximately 24% (Table 4), with a weighted average deviation of approximately 28%. If we limit our sample to projects with cost overruns, then the mean is 36% (Table 4). When comparing these numbers to those reported in the literature, the Portuguese experience in public project costs does not prima facie appear to be worse.

Figure 1 shows a histogram with the distribution of the cost deviations in our sample. Most of the projects have cost deviations between -20% (the costs are lower than the forecasts) and 40% (cost overruns). The cost deviation percentage is strongly skewed to the right, meaning that cost overruns are dominant. In fact, for every 10 projects, 7 have a positive deviation in the final cost. A quartile analysis indicates that 25% of the projects have a cost deviation equal to or below zero (projects with no cost overruns compose 37% of the sample), while 50% and 75% of the projects have deviations up to 5% and 24%, respectively. For the 90th percentile, the deviation reaches 54%.

[Insert Figure 1here]

Figure 2 presents a plot of the cost deviations against the year that each project was concluded. We observe some heteroscedasticity with lower cost deviation spreads in later years, which could indicate that the public sector has been improving in terms of efficiency.

[Insert Figure 2]

When dividing the sample between projects with cost overruns and projects without cost overruns, we have a total of 152 (63%) and 91 (37%), respectively. For the subsample of projects with cost overruns, the average cost deviation is 36% (Table 4). For the subsample with projects without cost overruns, the average deviation is only slightly negative (-1.5%), which confirms the skewness in cost overruns. A one-sample binomial test rejects the thesis that errors of overestimating costs are as common as the errors of underestimating costs, which signifies that forecast costs are biased and systematically underestimated.

Cost deviation statistics for different types of subsamples are presented in Table 4. The cost overruns of regional and local governments are substantially below the average and, hence, below that of the central government. While this suggests that regional and local governments are more efficient than the central government, we will test this explicitly in the next subsection wherein we control for project characteristics such as investment size, election years, etc. As the projects under the Parque Escolar programme are almost perfectly on target, they are an example of good planning and control.

[Insert Table 4 here]

Large projects have a higher cost overrun (33%) and are often projects that are concluded in election years (30%). Table 4 also shows the number of projects with cost overruns by subsample. It is interesting to note that the education sector has a substantial number of projects with modest cost overruns. Almost all (19 of 22) large projects have cost overruns. The same occurs for the central government and the years around elections.

4.2 Determinants of cost deviations

We estimate the determinants of cost deviations in public sector investment projects and present the results in Table 5. We observe in Models 1 to 5 that the dimension of the project increases the percentage of cost deviation. Large projects, while they are better planned, controlled, and monitored, are also more complex. The models also show that projects in the transport sector are negatively evident. Projects that are part of the Parque Escolar programme have fewer cost deviations (Model 3 and the sign is negative in all other specifications).

In Model 1, we observe that election years appear to have significant impact on cost deviations. We would have expected that projects concluded in election years would have more cost deviation for two reasons: (i) the average cost deviation in this subsample is higher than that in the total sample and (ii) there is a political tendency to open infrastructure in election years, which could induce pressure to speed up projects at the expense of cost control. When we focus on project cost overruns, we observe that the election year continues to be statistically significant and larger cost overruns occur. In Models 1, 4 and 5, the year prior to elections is negatively related to cost overruns. We also observe that the type of governing party, be it right or left wing, is not related to cost deviations on model 1 and 3. However, right wing governments appear to have some positive impact on cost overruns.

In relation to the legal and institutional variables, we find that the new 2008 procurement law has not had the expected effect. Rather than reducing cost deviations, the opposite has occurred (the coefficient is positive and statistically significant), which suggests that the new law has failed to promote a better and more transparent public procurement mechanism, even when controlling for economic environment. In contrast, a better general legal environment as measured by the rule of law has a significant impact in reducing cost deviations in public projects. Finally, we find a strong relation between corruption and cost deviations such that cost deviations increase when corruption exists.

[Insert table 5 here]

To estimate what variables affect the probability of a project having a cost overrun, we run a logit model and present the results in table 5

Consistent with the results from the previous subsection, large projects increase the likelihood of cost overruns. On the contrary, and related with the previous findings, projects in the transport sector reduce the probability of cost overruns. While projects concluded in the year before an election have lower cost deviations, the likelihood of cost overruns in election years is great, implying that governments accept cost escalations to complete the infrastructure, and hence, they also collect the political dividends. As before, we confirm that the new procurement law does not decrease the cost overruns and that positive cost deviations have actually increased since 2008. A higher level of corruption also increases the odds that a project will incur cost overruns.

5 Conclusions

We have analysed the cost deviations and cost overruns in public infrastructure investment projects in Portugal. The average cost deviation is 24%, with a weighted average of 28%. When

we consider only projects with cost overruns, the costs are 36% above budget. We find a clear scale effect on cost overruns as large projects, which are often more complex, have a longer duration, are subject to higher risk, and have a higher cost deviation and a higher probability of cost overruns. The public administration may not be well prepared to handle these types of projects. Transport projects have lower levels of cost deviations and a lower probability of cost overruns.

We also show that local and regional governments control costs better than the central government (even after controlling for project size, time period, election years, etc.). There is no great evidence that right or left wing governments are better or worse at adhering to budgets. Still, cost overruns are more likely in election years, as politicians seem eager to conclude infrastructural investments and thus inaugurate a new service to harvest political goodwill with the population. Over time, though cost deviations are reduced, this does not seem to be the result of the new procurement law of 2008 but is most likely the result of other factors, such as more experience, better projects, or increased fiscal constraints. Less corruption reduces not only the level of deviation but also the probability of cost overruns.

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Table 1 – Review of the main studies on cost deviations

This table presents the literature on cost deviations. n.a. denotes not available. Source: Own table.

Author	Region/ Country	Period	Nº projects/ sector	Average cost deviation	Main conclusions
Pickrell, 1990; Pickrell, 1992	USA	1980-1990	10 urban rail projects	50%	▪ 86% of projects have cost overruns ▪ Cost estimations are imprecise ▪ Cost deviations are similar across different projects and locations
Morris & Hough, 1991; S. Morris, 1990	India	1980-1990	290 projects	82%	▪ Cost deviations between 40% and 200% ▪ Reasons: delays, poor project concept, poor planning and implementation, bureaucracy, lack of coordination
Skamris & Flyvbjerg, 1997	Denmark	1990-1997	7 projects on bridges and tunnels	14%	▪ Cost overruns between 50% and 100% ▪ Optimism leads to underestimating cost forecasts
MacDonald, 2002	UK	1982-2002	50 projects	79%	▪ Strong optimism bias
Bordat, McCullouch, & Sinha, 2004	US	1996-2001	2668 projects on road construction / maintenance	4.5%	▪ 55% of projects have cost overruns ▪ Factors that influence cost overruns are contract bid amount, difference between the winning bid and second bid, project type and location by district
Odeck, 2004	Norway	1992-1995	620 projects	9%	▪ Cost deviations between -59% to +183% ▪ Cost overruns predominant in smaller projects
Flyvbjerg et al., 2002; Flyvbjerg, 2004 and 2007; Flyvbjerg, Skamris, & Buhl, 2003	USA, Europe and Japan	1910-1998	254 projects on rail, bridges, tunnels and roads	28%	▪ 90% of projects with cost deviations ▪ Average cost deviations for rail was 45%, 34% for bridges and 20% for roads ▪ Cost deviations do not reduce over time ▪ Larger projects have larger percentage cost escalations ▪ The main problem in megaproject development is pervasive misinformation about the costs, benefits, and risks involved ▪ Public ownership increases cost deviations

Author	Region/ Country	Period	Nº projects/ sector	Average cost deviation	Main conclusions
Magnussen & Olsson, 2006	Norway	1999-2005	31 projects: transport, building, defence, IT	9%	▪ Cost deviations decreased after introduction of quality assurance measures ▪ 74% of projects have cost deviations ▪ Project scale has no impact on cost deviations
Ellis et al., 2007	US	1998-2006	3.130 state road projects	8% to 9%	▪ Projects by traditional procurement perform worse than those by alternative contract forms
Blanc-Brude et al., 2006, 2009	Europe	1990-2005	227 projects: road sector	24%	▪ PPP road projects have more cost deviations than traditional procurement projects ▪ Largest part of ex-ante construction cost difference originates from transfer of construction risk
NAO, 2007a, 2007b	UK	2004-2007	36 and 20 road projects	6% and 18%	▪ Project changes and cost underestimations are main sources of overruns ▪ Complex projects have higher cost overruns ▪ Local governments are more efficient
Aibinu & Pasco, 2008	Australia	1999-2007	56 construction projects	10%	▪ Cost estimates of smaller projects more inaccurate than those of larger projects ▪ Cost deviations do not improve over time
Lee, 2008	South Korea	1985-2005	138 road and 16 rail projects	Roads: 11%; Rail: 48%	▪ 86% of projects have cost overruns
Kaliba et al., 2009	Zambia	2000-2005	8 projects	70%	▪ Inflation and government interference, weather, schedule delays, strikes, technical challenges, and environmental protection cause cost escalations
Creedy et al., 2010	Australia	1995-2003	231 road projects	16%	▪ No correlations between project size and cost overruns ▪ Cost overruns are induced by changes in project ▪ Risk is not properly assessed

Author	Region/ Country	Period	Nº projects/ sector	Average cost deviation	Main conclusions
Cantarelli, 2009; Cantarelli, Flyvbjerg, Molin, & van Wee, 2010; Cantarelli, Flyvbjerg, & Buhl, 2012; Cantarelli, Molin, van Wee, & Flyvbjerg, 2012; Cantarelli, van Wee, Molin, & Flyvbjerg, 2012	Netherlands	1980-2008	87 projects on roads and rail	10%	▪ Cost deviations ranged between -46.8 and +90.3% ▪ Average cost deviation for road sector was 20% ▪ For rail projects, Dutch projects perform well
Singh, 2010	India	1992-2009	157 projects	16%	▪ Contractual and institutional failures lead to cost and time overruns ▪ Incomplete contracts are source of cost overruns
Makovšek et al., 2011	Slovenia	1995-2007	56 road projects	19%	▪ Time effect in reducing cost overruns ▪ No scale effect in cost overruns
Lundberg et al., 2011	Sweden	1997-2009	102 projects on roads and rail	11%	▪ No time or scale effects on cost deviations
Bent Flyvbjerg & Stewart, 2012	Several countries	1960-2012	Olympic Games infrastructure	179%	▪ All OG have cost overruns, larger than other types of megaprojects ▪ Infrastructure associated with large events is most risky
Bucciol et al., 2013	Italy	2004-2009	1093 small projects	8%	▪ Cost overruns are smaller under the Italian average bid format, but only when this format is combined with restricted entry

Author	Region/ Country	Period	Nº projects/ sector	Average cost deviation	Main conclusions
Ansar et al., 2014	65 countries	1934-2007	245 large dam projects	96%	▪ Costs are systematically underestimated ▪ A scale effect in increasing cost overruns ▪ No time effect in improving cost estimations ▪
Sovacool et al., 2014	57 countries	n.a.	401 electrical infrastructure projects	66%	▪ Only 9% of projects with no cost overruns ▪ Cost overruns are multi-causal ▪ Electrical infrastructure seems prone to cost overruns, independent of the technology or location ▪
Shehu, Endut, Akintoye, & Holt, 2014	Malaysia	n.a.	359 projects on education and health	12%	▪ 45% of projects completed at or below contract sum ▪ Large projects were completed at a cost overrun below 10%
Odeck, 2014	Norway	1993-2007	1.045 projects	10%-20%	▪ Public sector reform: no reduction in cost overruns ▪ More competition reduces overruns ▪ Separating planning and construction into two government departments eliminates cost overruns; privatisation of construction reduces cost overruns

Table 2 - Variables

This table describes the independent variables used in this study. N/D means that our model does not specify an expected signal for that variable. Source: Own table.

Variables	Type	Definition	Expected signal	Reasons
Sectors: Education, transports, social facilities and economic facilities	Dummy 0 – No 1 – Yes	Project sector	N/D	No evidence that a specific sector has more cost deviations or overruns.
Project variables				
Subsector	Dummy 0 – central government 1 – regional/ local government	Level of government	+	Regional and local governments may be less efficient than the central government.
Parque Escolar	Dummy 0 – No 1 – Yes	Project under Parque Escolar program	-	This infrastructure program may be more efficient in terms of cost estimations.
Large project	Dummy 0 – No 1 – Yes	If the project is considered a large project	+	Large projects may to be more prone to cost deviations.
Political variables				
Election year lag	Dummy 0 – No 1 – Yes	Project concluded in year before elections	+	Politicians tend to inaugurate public works and infrastructure projects before elections to obtain political benefits.
Election year	Dummy 0 – No 1 – Yes	Project concluded in an election year	+	
Right Wing Government	Dummy 0 – Socialist 1 – Liberal	Left of right wing party in government at time of project contract	N/D	Right wing parties have better business links and could be more realistic in forecasting costs and revenues.
Legal and institutional variables				
2008 Procurement Law	Dummy 0 – No 1 – Yes	Before or after the introduction of 2008 procurement law	-	The new procurement law should improve public procurement and reduce cost deviations.
Rule of law	Discrete	Index (1-100; 100 is best)	-	This index indicates the quality and strength of the legal system. A better legal system should reduce cost overruns
Corruption index	Discrete	Index (1-10; 10 is best)	-	Low corruption should reduce cost overruns.

Source: Authors

Table 3 – Descriptive statistics

This table presents the descriptive statistics of the variables used. Source: Own table

Variable	Obs	Mean	Std. Dev.	Min	Max
Sector variables					
Education	243	0.26	0.44	0	1
Transports	243	0.26	0.44	0	1
Social facilities	243	0.30	0.46	0	1
Project variables	243				
Subsector	243	0.54	0.50	0	1
Parque Escolar	243	0.13	0.34	0	1
Large project	243	0.08	0.28	0	1
Political variables	243				
Election year lag	243	0.50	0.50	0	1
Electionyear	243	0.35	0.48	0	1
Right wing government	243	0.13	0.34	0	1
Institutional and legal variables	243				
2008 Procurement law	243	0.71	0.45	0	1
Rule of law	243	2.21	0.32	1.5	2.5
Corruption	243	6.19	0.27	5.8	6.7
Economic variables					
GDP growth	243	0.72	2.06	-3.2	3.6
Inflation	243	2.13	1.31	-0.8	4.3
Deficit	243	-6.54	2.97	-9.8	-2.7

Table 4 – Cost deviations by subsample type

This table presents the size of cost deviations for various subsamples. The average in each sample is the weighted average, which considers the specific weight of each project in the total cost and deviations. Positive numbers in cost deviations represent a cost overrun, and negative numbers represent a cost below the forecast. n.a. stands for not applicable. Source: Own table.

Samples	Nº Projects	% of projects with cost overruns	Cost deviations						
			Average	Median	St Dev	C.I 95%		Min	Max
Total sample	243	63%	24.0%	4.6%	41%	18.81%	29.24%	-42%	278%
Cost with overruns	152	n.a	36.0%	18.7%	48%	28.39%	43.61%	1%	278%
Large projects	20	86%	32.6%	54.0%	91%	-7.16%	72.30%	-13%	278%
Parque Escolar	32	59%	0.4%	0.1%	2%	-0.18%	0.90%	-2%	7%
Central government	112	74%	25.6%	6.4%	57%	15.01%	36.13%	-42%	278%
Regional and local government	131	53%	13.5%	3.4%	16%	10.77%	16.30%	-7%	84%
Election year lag	122	60%	26.4%	0.7%	46%	18.27%	34.52%	-42%	278%
Election year	86	53%	29.5%	0.2%	42%	20.64%	38.41%	-31%	219%
After 2008	172	55%	15.7%	0.2%	14%	13.64%	17.81%	-8%	59%

Table 5 – Determinants of cost deviations

This table presents the results of the determinants of infrastructural investments' cost deviations. Model 1 is based on an OLS regression, while Model 2 is an OLS with year effects (which necessitates dropping variables that are not time dependent). Model 3 is a generalised linear model, with left censoring as only projects with positive cost deviations (as cost overruns) are included. Model 4 is a Tobit model with left censoring (for cost overruns only). Model 5 is a Tobit model with left censoring and right censoring (projects with cost overruns above 100% were dropped). Model 6 is a logit model on cost overruns (projects with a cost exceeding the cost forecasts). Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Source: Own table.

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation method	OLS	OLS	GLM with left censoring	Tobit with left censoring	Tobit with left censoring	Logit
Sample	All	All	Cost overruns only	Cost overruns only	Cost overruns only (without outliers)	All
VARIABLES						
Sector variables						
Education	0.08	0.07	0.11	0.19*	0.14**	0.88
	(0.05)	(0.08)	(0.07)	(0.11)	(0.07)	(0.68)
Transports	-0.12**	-0.11*	-0.07	-0.32***	-0.19***	-1.96***
	(0.05)	(0.07)	(0.10)	(0.10)	(0.07)	(0.65)
Social facilities	0.05	0.07	0.04	0.07	0.04	0.84
	(0.05)	(0.06)	(0.07)	(0.09)	(0.06)	(0.58)
Project variables						
Subsector	0.05	0.02	0.01	-0.01	-0.01	-0.59
	(0.06)	(0.06)	(0.06)	(0.08)	(0.05)	(0.57)
Parque Escolar	-0.15***	-0.13	-0.28***	-0.31**	-0.28***	-1.27
	(0.05)	(0.09)	(0.08)	(0.13)	(0.09)	(0.78)
Large project	0.67***	0.73***	0.52***	0.77***	0.52***	3.16***
	(0.15)	(0.09)	(0.16)	(0.11)	(0.08)	(0.81)
Political variables						
Election year lag	-0.33***		-0.23	-0.49***	-0.35***	-4.73***
	(0.12)		(0.26)	(0.18)	(0.13)	(1.66)
Election year	0.30***		0.41***	0.16	0.10	4.22*
	(0.11)		(0.10)	(0.10)	(0.07)	(2.16)
Right wing government	0.16		0.18	0.55***	0.44***	4.40*
	(0.12)		(0.13)	(0.18)	(0.13)	(2.30)
Legal and institutional variables						
2008 procurement law	0.43***		0.33	0.63***	0.44***	4.83***
	(0.13)		(0.26)	(0.18)	(0.13)	(1.25)
Rule of law	-1.14***		-1.24***	-0.99***	-0.59**	0.22
	(0.30)		(0.43)	(0.34)	(0.23)	(2.62)
Corruption	2.07***		1.93***	2.81***	2.17***	14.81***
	(0.40)		(0.49)	(0.42)	(0.29)	(4.56)
Economic variables						
GDP growth	0.04		0.06	0.06*	0.04*	-0.04
	(0.03)		(0.04)	(0.04)	(0.02)	(0.38)
Inflation	-0.01		0.01	-0.13***	-0.11***	-1.24***
	(0.02)		(0.03)	(0.05)	(0.03)	(0.32)
Deficit	-0.06***		-0.05**	-0.07**	-0.07***	-0.32
	(0.02)		(0.03)	(0.03)	(0.02)	(0.30)
Constant	-10.82***		-9.69***	-15.76***	-12.50***	-90.38***
	(2.29)		(2.68)	(2.69)	(1.87)	(27.95)
Year effects	No	Yes	No	No	No	No
Observations	243	243	152	152	140	243
R-squared	0.54	0.56	-----	0.49	0.62	0.43

Figure 1 – Histogram of cost deviation

This figure presents the histogram of the cost deviation for all 243sample projects. The cost deviation of each project is on the x-axis is. The percentage of projects with cost deviations by interval is on the y-axis. Source: Authors' data.

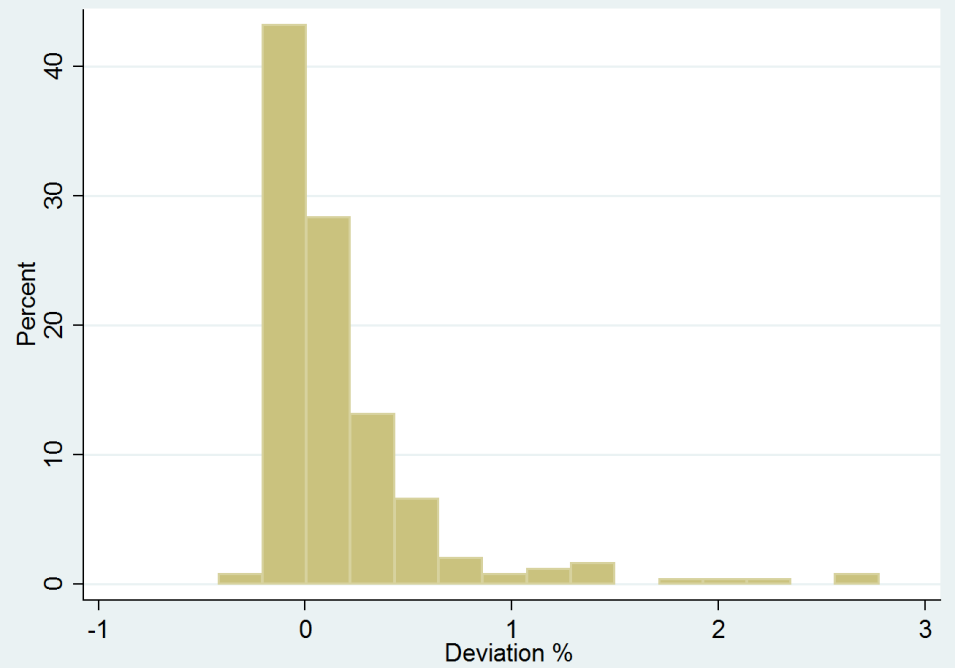

Figure 2 –Cost deviation by year

This figure represents the scatter plot between the cost deviations and the year of the project's conclusion. Source: Authors' data.